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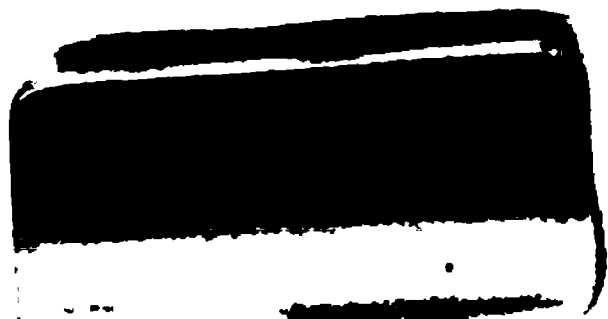
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ANNUAL REPORT

OF THE

State Engineer and Surveyor

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With the compliments of

Edward A. Buel

o, 1898.

State Engineer and Surveyor.

TRANSMITTED TO THE LEGISLATURE JANUARY 30, 1899.

WYNKOOP HALLENBECK CRAWFORD CO.,

STATE PRINTERS,

NEW YORK AND ALBANY.

1899.

ANNUAL REPORT

OF THE

State Engineer and Surveyor

1898

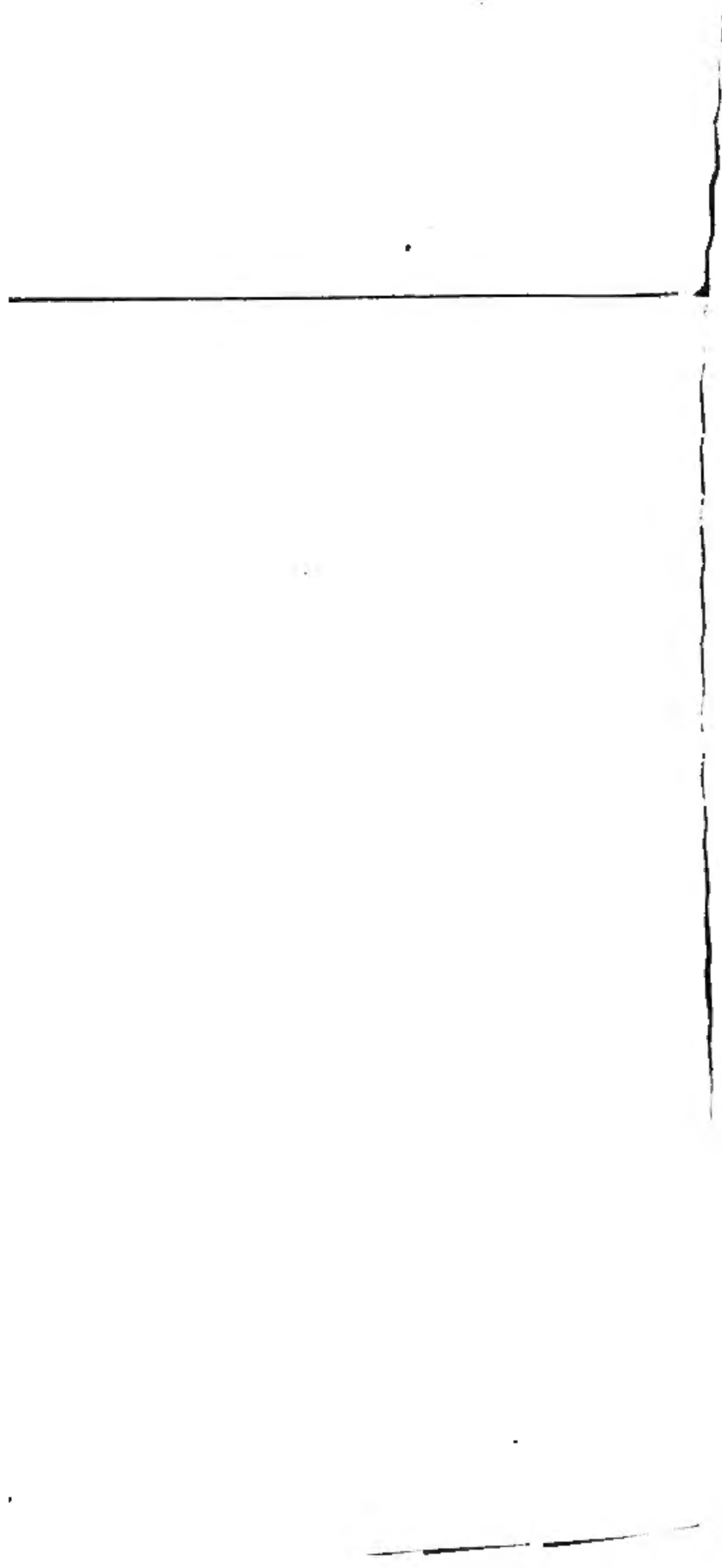
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1899.



ANNUAL REPORT

OF THE

State Engineer and Surveyor

OF THE

STATE OF NEW YORK,

For the Fiscal Year Ending September 30, 1898.

TRANSMITTED TO THE LEGISLATURE JANUARY 30, 1899.

WYNKOOP HALLENBECK CRAWFORD CO.,
STATE PRINTERS,
NEW YORK AND ALBANY.
1899.

STATE OF NEW YORK.

No. 72.

IN ASSEMBLY,

JANUARY 30, 1899.

ANNUAL REPORT

OF THE

STATE ENGINEER AND SURVEYOR.

ALBANY, *January 30, 1899.*

To the Honorable the Speaker of the Assembly:

SIR.—I have the honor to transmit herewith to the Legislature the annual report of my predecessor, Hon. Campbell W. Adams, for the year ending September 30, 1898.

Yours respectfully,

EDWARD A. BOND,

State Engineer and Surveyor.

OFFICE OF THE STATE ENGINEER AND SURVEYOR, }
ALBANY, *January* 30, 1899. }

HON. EDWARD A. BOND,

State Engineer and Surveyor :

SIR.—I herewith enclose for transmission to the Legislature the annual report of the State Engineer and Surveyor for the year ending September 30, 1898.

Yours respectfully,

CAMPBELL W. ADAMS.

REPORT

OFFICE OF THE STATE ENGINEER AND SURVEYOR,

ALBANY, N. Y., *January 30, 1899.*

To the Honorable the Legislature of the State of New York:

I have the honor to submit the following report of work done by this department during the fiscal year ended September 30, 1898, together with such remarks and recommendations as seem pertinent under existing circumstances, covering the department work to December 30, 1898.

The year in question has been another of the busiest ones ever witnessed by this department. In fact, I am confident it cannot be disputed that the five years covering the past two terms have witnessed the execution of more work by this department than during any continuous five years of its previous history.

During the past year, in addition to other work, forty-five final accounts have been prepared, covering a total, as will be seen in the attached tables, of over a million and a half dollars. Sixty-three other contracts are still pending in addition to a large number of pieces of work that are being done under the ordinary and extraordinary repair laws. In addition to supervising the planning and execution of this enormous amount of work, the State Engineer is the chairman of the drainage committee of the State Board of Health and must approve or modify the plans for every sewer system built in this State outside of cities, and investigate nuisances and other matters brought to the attention of the State

Board of Health; he is a member of the Forest Preserve Board, and in the present instance has not only studied the subject of the acquisition and preservation of Adirondack lands on paper, but in numerous instances has actually examined the ground in company with his colleagues. He is a member of the State Land Board and in that capacity has received and disposed of seventy-two applications for land under water during the past fiscal year. Twenty-four of these applications were contested. Also in this connection fifty-five sales of land have been held embracing two hundred and fifty-six separate parcels for which \$22,637.67 have been received and paid to the State Treasurer.

He has, during the last two terms, completed the surveys and mapping of the State's boundary lines where those lines touch Pennsylvania, New Jersey and Massachusetts, and for the first time in its history the State now has those lines carefully surveyed, mapped and monumented, and the records thereof put in tangible shape. He has during the last five years, in co-operation with the United States Government, completed the surveys and maps of 10,655 square miles of the area of this State. He was a member of the Greater New York Commission and in framing the charter of that city, he undoubtedly rendered the State a valuable service in protecting the State's interest as against that of the city in the matter of the lands under the navigable waters in that city. He was a member of the Quarantine Commission and had charge of and executed improvements to the value of over \$250,000 at the Quarantine Station on Hoffman Island, consisting in the enlargement of that island, artificially, to about five times its original size. He was a member of the Capitol Commission, and in that capacity took an active part in the awarding of substantially every contract, except for

electric wiring and lighting, that was required to complete that building, and this was all done before Governor Black's term began. He was a member of the Canal Board and almost every matter that required the attention of that board and which, during the past two terms has involved the expenditure of probably over thirteen million dollars, originated in his office.

He has, since 1894, had charge of the surveys for all the oyster lands of the State in the waters adjacent to Long Island, and during the past year he has had full charge of the prosecution of all work done under the first so-called Good Roads Law adopted by this State. The duties connected with the foregoing work do not, by any means, cover all that must be done by the State Engineer. Such of these duties as are connected with the various boards and commissions, of which he is a member ex-officio, must be done by him individually; even his single deputy being debarred by law from acting for him in such matters. Yet, in addition to these burdens he has been charged with the planning and an equal voice with the superintendent of public works in the execution of the so-called canal improvements which have involved an expenditure of nine million dollars, the total sum available, but which has sufficed for the completion of only two hundred of the four hundred and fifty-four miles which it was hoped to have improved with this sum. Probably some mistakes were made in the plans, estimates, specifications and execution of this work, and some eminent gentlemen and jurists have conceived it to be their duty to entirely overlook the arduous duties which the State Engineer had otherwise to perform and hold him singly and personally responsible even to a criminal extent, for every error either of omission or commission, whether committed by himself or his assistants, on the latter of whom certain specific duties are devolved by law.

The subject of the canal improvements has been thoroughly (?) investigated in a most unfair manner. Following the report of the investigating commission, not even the semblance of fairness to the canal officials has been introduced in any stage of the proceedings and up to date, the State Engineer at least, has not been given an opportunity to explain any feature that might have seemed questionable, and has even been denied the privilege of explaining, when that privilege was asked for. Up to date the merits of the case have not been analyzed by anyone outside of this department. The reasons for omitting from the original estimates much of the work that has since been found necessary, and the reasons why this work has since been found necessary are apparently of no concern except to the two departments that have been charged with such gross incompetency. However, since the discussion of the whole question seems in a fair way of being continued in the courts, I do not think it either necessary or desirable that it be continued here, but, for the purpose of record, I desire to have incorporated in this report a statement forming Appendix No. 1, which I prepared in relation to the investigating commission's report. A similar review of Judge Countryman's review of the testimony and the commission's report thereon should properly be included with this, but at present I have neither the time nor the inclination to prepare it. Suffice it to say that the latter report perpetuates all of the unfairness and most of the mistakes of the former and at the same time adds many new ones, both relating to figures and to facts.

The profile on the opposite page shows the location and extent of each of the canal improvement contracts that has been or is yet to be awarded, together with the names of the contractors

and other data. It also indicates those contracts for which final accounts have been submitted; a statement is also submitted herewith, showing the number of each contract on each division on which any work has been done. The amounts shown by heavy faced type indicate that those contracts are closed and that the amount is final. In the other cases, the amount shown is for the total amount of work done up to date. The only possible exception to this will be Eastern Division Contract No. 10, which is not yet in final form. This table shows on the unfinished contracts the total amount earned—not paid—and from those amounts ten per cent. deducted will show the amounts paid and the amount of retained percentage remaining in the treasury:

Canal Improvement.
AMOUNTS EARNED ON CONTRACTS.
(December 31, 1898.)

EASTERN DIVISION.				MIDDLE DIVISION.				WESTERN DIVISION.			
Con.	Laws of 1898, Chap. 79.	Total.		Con.	Laws of 1898, Chap. 79.		tal.	Con.	Laws of 1898, Chap. 79.	Laws of 1898, Chap. 506.	Total.
1	\$80,845 30	\$80,845 30		1	\$301,155 15		\$301,155 15	1	\$636,989 87		\$636,989 87
2	127,946 10	127,946 10		2	300,287 48		300,287 48	2	445,950 00		445,950 00
3	55,308 43	55,308 43		3	234,339 27		234,339 27	3	723,935 83		723,935 83
4	130,035 43	130,035 43		4	906,850 00		906,850 00	4	68,060 00		68,060 00
5	66,640 00	66,640 00		5	242,403 76		242,403 76	5	11,097 47		11,097 47
6	141,591 14	141,591 14		6	14,020 00		14,020 00	6	\$1,845 00		\$1,845 00
7	89,940 41	89,940 41		7	5,700 00		5,700 00	7	275,190 00		275,190 00
8	116,634 00	116,634 00		8	9,990 00		9,990 00	8	61,600 00		61,600 00
9	245,750 00	245,750 00		9	15,740 00		15,740 00	9	75,140 00		75,140 00
10	118,339 73	118,339 73		10	47,490 00		47,490 00	10	58,730 00		58,730 00
11	92,937 29	92,937 29		11	32,129 25		32,129 25	11	79,610 00		79,610 00
12	45,315 35	45,315 35		12	18,751 15		18,751 15	12	33,430 00		33,430 00
13	12,756 33	12,756 33		13	16,985 15		16,985 15	13	57,260 00		57,260 00
14	82,475 26	82,475 26		14	17,867 05		17,867 05	14	31,310 00		31,310 00
15	72,049 68	72,049 68		15	85,130 95		85,130 95	15	66,430 00		66,430 00
16	81,070 00	81,070 00		16	100,075 15		100,075 15	16	7,340 25		7,340 25
17	106,360 00	106,360 00		17	9,402 44		9,402 44	17	730 00		730 00
18	14,140 00	14,140 00		18	305,336 76		305,336 76	18			
19	58,160 00	58,160 00		19	302,630 00		302,630 00	19			
20	56,680 00	56,680 00		20	75,600 00		75,600 00	20			
21	40,330 00	40,330 00		21	69,446 00		69,446 00	21			
22	30,000 00	30,000 00		22	139,310 00		139,310 00	22			
23	31,020 33	31,020 33		23	149,610 00		149,610 00	23			
24	36,367 73	36,367 73		24	112,340 00		112,340 00	24			
25	5,036 31	5,036 31		25	109,940 00		109,940 00	25			
26	2,350 37	2,350 37		26	367,600 00		367,600 00	26			
				27	322,740 00		322,740 00	27			
				28	159,670 00		159,670 00	28			
				29	79,460 00		79,460 00	29			
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Above all the bitter personalities that have grown out of this subject, it is pleasing to note that the overwhelming sentiment of the people seems to be that the work should be carried on to completion. In this connection I wish to call attention to the estimates for completing the work prepared by the investigating commission's engineers. After charging that the work already done has been wildly extravagant and subject to gross irregularities and abuses, they estimate that the work remaining to be done will cost at a rate per mile considerably in excess of the rate for the work already done, notwithstanding it is a well known fact that the work already done covers the most difficult and expensive section of the canal. Surely there must be a discrepancy somewhere.

I believe that the completion of the work will produce adequate results toward the improvement of the commerce of the whole State and especially of New York city, but I also believe that proper foresight demands that the scope of the improvement should be so modified as to provide for nine feet of water throughout the Erie and Oswego canals, instead of only between structures over which the depth as now required is eight feet, and I also believe that the locks should be slightly altered by substituting a different form of gate so as to accommodate boats 115 feet long instead of 98 feet as at present. Neither of these changes would cost a comparatively great sum of money, and since they would enable the present boats, with slight alterations, to increase their cargo 64 per cent. instead of the 20 per cent. that will be possible on the completion of the improvement as outlined, the reason for the suggestion should be apparent.

I also believe that all restrictions on the capitalization of companies doing business on the canals should be removed, and that every facility should be afforded for the organization and operation of companies thoroughly equipped with money, brains and determination to do the business that should properly seek our route to the seaboard in a thoroughly up-to-date manner. In my former annual reports I have stated the reasons for this belief at considerable length and I am now more than ever convinced of the propriety of the courses suggested.

GOOD ROADS.

A great deal of interest seems to have been manifested in the subject of improvement of public highways since the enactment of the first general law for that purpose, chapter 115 of the Laws of 1898. Up to date 86 petitions have been received, divided between the counties as follows:

Chemung, 2; Clinton, 5; Columbia, 1; Erie, 7; Herkimer, 4; Monroe, 15; Montgomery, 1; Oneida, 2; Onondaga, 9; Orange, 8; Orleans, 1; Rensselaer, 4; Rockland, 11; Schenectady, 5; Ulster, 1; Saratoga, 5; Westchester, 1; Albany, 1; Delaware, 2; St. Lawrence, 1.

Owing to the meagre descriptions given in the petitions in some cases, it is well nigh impossible to decide as to the distance covered, but a fair estimate for all of the above petitions would be about 450 miles. Some delay has been experienced in getting the work started on account of the necessity of organizing the forces of the Department for work in hand, designing and preparing books and blanks and attempting to put the Department in proper shape for the inception and future prosecution of what must eventually become a vast undertaking.

Chapter 607 of the Laws of 1898 appropriated \$50,000 for good roads work. The roads petitioned for would cost probably \$2,000,000, so it will be easily apparent why it has been impossible, under the circumstances, to apportion the first year's work with any great degree of satisfaction to anybody concerned. Knowing that only a small amount of work could be done, the aim has been to build short sections in localities near the larger centres of population, so to have them form object lessons to as large a number of people as possible. Moreover, it was believed that these sections were entitled to first consideration, because of the amount of taxes which they paid.

In addition to the work that has been placed under contract, surveys have been made on a number of roads in Orange, Rockland, Rensselaer, Onondaga, Montgomery, Erie and Monroe counties. The plans resulting from these surveys are in a more or less advanced condition and some of them are practically ready to be returned to the various boards of supervisors for their action on the final petition. However, it was well known that the first five contracts, as hereinafter described, would come so near using up the available funds that it would be unsafe to award any further contracts, and until further funds are available, it is questionable what should be done toward completing the unfinished plans.

Since the law provides that contracts must be awarded in the order in which the final petitions are received in this office, we have numbered the various roads for identification to correspond with the numbers of the final petitions. These are as follows:

ROAD No. 1. This road covers 2 miles of the Troy and Schenectady turnpike, easterly from the city line of Schenectady, in the

town of Niskayuna, Schenectady county. The contract for this work was awarded to the Callanan Road Improvement Company, of Albany, September 7, 1898, and was to have been finished by November 15th last, but owing to the continued inclement weather it was impossible to do more than finish about half of the work last fall, and the time for completion was accordingly extended to June 1, 1899. This road is to be graded to a width of 22 feet and have a strip of limestone macadam in two courses, 16 feet wide, to be rolled to a finished thickness of 6 inches. The Engineer's estimate of cost for this work was \$14,600.06, exclusive of engineering and advertising. It was awarded to the Callanan Road Improvement Company for \$14,590. The only other bid received was from J. P. Monty, of Sandy Hill, for \$13,498, but the sample of stone submitted with this bid was of sandstone, and, therefore, not satisfactory either to the local authorities or to this Department.

ROAD No. 2. This road extends from the southerly city line of Buffalo to the northerly line of the village of Hamburg, through the towns of Hamburg and West Seneca, a distance of 7.54 miles, excepting therefrom 1 mile through the incorporated village of Blasdell. The petition for this work originated with the adjoining property owners. The width of road adopted is 22 feet, with a macadam strip through the centre consisting of two courses of Yarmathal limestone of a finished thickness of 6 inches and a width of 12 feet. The Engineer's estimate, exclusive of engineering and advertising, was \$34,786.25. The contract was awarded October 4, 1898, to Henry P. Burgard, of Buffalo, N. Y., for \$24,750. The work was to have been finished by January 1, 1899, but owing to the nature of the clay soil and the continued inclement weather, it has been necessary to extend

this time to June 1, 1899. The bids received for this work were as follows:

Henry P. Burgard, Buffalo, N. Y.....	\$24,750 00
O'Day & Albaugh, Rochester, N. Y.....	25,990 00
Williams, McNaughton & Bapst, Buffalo, N. Y....	28,995 00
Louis H. Gipp, Tonawanda, N. Y.....	30,500 00
G. M. & C. V. Busch, Buffalo, N. Y.....	31,199 77
Brown, Stabell & Griffith, Buffalo, N. Y.....	33,581 00
James B. Donnelly, Buffalo, N. Y.....	33,900 00
Waddle & Fitch, New York city.....	34,743 00
Michael J. Dady, Brooklyn, N. Y.....	37,405 00

ROAD NO. 3. This is known as the River road, and extends from Deerfield Corners easterly, in Oneida county, to the westerly line of Herkimer county, a distance of 2.25 miles. The petition for this work originated with the property owners. The width of road adopted is 22 feet, with a macadam strip through the centre consisting of one course of limestone 4 inches thick and a surfacing course of trap rock 2 inches thick, both after rolling. The width of the macadam is 12 feet. The engineer's estimate, exclusive of engineering and advertising, was \$15,968. The contract was awarded October 4, 1898, to James J. Dwyer & Co., of Utica, N. Y., for \$13,806.35. This work was to have been finished by January 1, 1899, but owing partly to the continued inclement weather and partly to the inability of the contractor to procure stone, it has been necessary to extend the time for completion to June 1, 1899. The bids received for this work were as follows:

James J. Dwyer & Co., Utica, N. Y.....	\$13,806 35
Johnson & Connors, Fulton, N. Y.....	14,796 00
Pius Kerner, Utica, N. Y.....	15,179 00
Walter A. Cook, Jr., Merithon, N. Y.....	15,254 00
O'Brien & Hoolihan, Syracuse, N. Y.....	16,326 00

ROAD No. 4. This road extends from a point in the old road leading from New Lebanon over Lebanon mountain, to Pittsfield, Mass., by an entirely new route, 1.25 miles long, up to the Massachusetts State line, where it will connect with a new State road built by Massachusetts. The old road was well nigh impassable at certain seasons, and its grades were very steep, being in places at the rate of 18 per cent. The new road has a 5 per cent. grade throughout its length, and forms a striking example of what may be accomplished in such cases with the aid of proper engineering skill. The work is entirely within the town of New Lebanon, Columbia county. The petition for this work originated with the supervisors. The width of road adopted is 21 feet, which is to be surfaced with gravel in order to save expense on first cost. The Engineer's estimate, exclusive of engineering and advertising, was \$7,875. The contract was awarded October 20, 1898, to Edward A. Mathews, of Binghamton, for \$7,200. This work is to be completed July 1, 1899. The bids received for this work were as follows:

Edward A. Mathews, Binghamton, N. Y.....	\$7,200 00
W. J. Dyer, Syracuse, N. Y.....	7,239 00
Myron R. Fisk, Huntington, Mass.....	7,775 00
William F. Doyle, Albany, N. Y.....	7,980 00
Hendrick & Wright, Springfield, Mass.....	9,000 00
Shute & Wrightmeyer, Hudson, N. Y.....	9,850 00

ROAD No. 5. This is a continuation of East avenue, Rochester, and extends from the east line of the village of Brighton (about 1.25 miles east of the city line) to the Pittsford and Fairport fork, a distance of 2.45 miles. The adopted plans call for a roadway 22 feet wide, with a 12-foot strip of macadam through the

centre, consisting of two courses of limestone rolled to a finished thickness of 6 inches. The original specifications for this work provided for a surfacing course of trap rock, which was afterward changed to limestone in deference to the wishes of the local parties interested, because it was believed that the additional cost of trap rock would interfere with the progress of the road improvement movement in Monroe county. Five bids were received January 9, 1899, as follows:

H. P. & W. A. Gillette, Rochester, N. Y.....	\$8,200 00
Chambers & Casey, Rochester, N. Y.....	10,200 00
Lauer & Hagaman, Rochester, N. Y.....	10,650 00
Whitmore, Rauber & Vicinus, Rochester, N. Y.....	10,790 00
William H. Jones & Sons, Rochester, N. Y.....	14,000 00

This contract has not yet been awarded, because the local authorities now desire to change back to the surfacing course of trap rock, particularly since the lowest bid is so far under the engineer's estimate, which was \$10,993, exclusive of advertising and engineering.

ROAD No. 6. This is known as the Ridge road, and extends from the northerly boundary of the city of Rochester to the west line of the town of Greece, through the town of Greece, Monroe county, a distance of 6.53 miles. The plans and estimate for this work have been duly approved by the board of supervisors of Monroe county, but the contract could not be awarded because of the scarcity of funds available on the part of the State.

The percentage of work done on the different contracts that have been awarded is as follows: No. 1, 47 per cent.; No. 2, 17 per cent.; No. 3, 31 per cent.; No. 4, 47 per cent.

The plan thus far adopted in the letting of contracts has been to prepare the plans and specifications with such minuteness of detail as to make it possible to award all contracts for a lump sum, and it is gratifying to know that each contract has been awarded at considerably less than the engineer's estimate, and that it has not thus far been necessary to make any alterations in the plans or specifications that would add to the cost of the work. This course is believed to be especially desirable in this case, because the whole cost is not borne by the State. The work thus far has admitted of this treatment without serious difficulty, because, unlike most of the canal work, the quantities can be accurately determined in advance.

The placing of this entire work, including the advertising and awarding of contracts, in the charge of this Department, was quite a radical departure from recent precedent, at least so far as State work is concerned, but I believe it was the proper course, and I wish to lay especial emphasis on the fact that the supervision of all the work thus far done, including the clerical work required in this Department, has not cost the State an extra penny. However, if further and larger appropriations are to be made available for continuing this work it will undoubtedly be found desirable to make provision for a special deputy in this Department to have charge of good roads matters. The enormous amount of work which the State Engineer is called upon to do will render this course necessary if this important subject is to receive the attention which it so richly merits. The first appropriation was so meagre that it was known that little work could be done, and it was believed that in the organization of the Department for the work in hand, under such circumstances, it would be best for the State Engineer or his present deputy to

attend to the details personally until the work should have been fairly started. It has, therefore, been found impossible to find time to comply with the law's provisions about holding meetings for the discussion of good roads matters in the various counties. A fund of useful information is now available concerning this most important subject. But to keep posted as to what has been and is now being accomplished in this line in other localities, and collate that information and put it in such shape as to be of the greatest benefit to the people of this State, so to put this Department in shape to lead and not to follow public opinion on this matter, will certainly require the undivided attention of a capable engineer. The clerical and other assistance that will be required is already available, and the Department already has an organization thoroughly equipped, reaching into almost every county of the State, and ready to take up at short notice and execute promptly any work of this kind that may hereafter be ordered.

I desire to call especial attention to the cost of advertising and engineering connected with this work. It will be seen from the schedule of bids received that fair competition has been had on each contract thus far, while the total amount of advertising expenses has been as follows:

Road No. 1, \$50.

Road No. 2, \$34.37.

Road No. 3, \$36.55.

Road No. 4, \$37.50.

Road No. 5, \$37.50.

The engineering expenses cannot yet be foretold, as none of the work is finished, but as compared with other work on the canals, such expenses will appear rather out of proportion to the

total cost of the work. There are two good reasons for this, which will be easily apparent. First, the preparation of surveys and plans for lump sum bids must be done with greater exactness and attention to detail than would be required if the work were to be done at unit prices. Second, the unvarying rule is that the work is very light and the cost per running foot, as compared with railroad or canal work, is very slight. However, it costs just as much to stake out a cutting 1 foot deep as it would if that cutting were 10 feet deep. In fact, the light skimming nature of the grading to be done requires a larger number of stakes than would be necessary on any other sort of public work. We have, however, felt that the reputation of the Department was at stake on this matter, and all good roads expenditures have been scrutinized with special care.

I had hoped to be able to bring to your attention in this report some specific recommendations concerning changes in this Good Roads Law, and, in fact, all the other laws relating generally to the subject of highways; but owing to the enormous amount of work that has devolved on this office in connection with the canal matters during the past year it has been impossible to find the time to take up the subject in a thorough manner. I think it will be conceded that on account of the very numerous amendments that have been made in recent years to the general highway law and the passage of other laws pertaining to the same subject that are entirely separate from the general law, the time has now arrived for a general revision of all the laws relating to this subject, and the passage of one general law to take the place of those now existing, so as to put the matter in an intelligent form. To do this a vast amount of work will be required. Some of the laws are obsolete and should

be repealed, while many additions and modifications should be made. I feel that good results will follow the revision of these laws if the work could first be outlined by this Department. The subject demands the most careful study, and until this study can be applied to the whole subject in a comprehensive manner it would probably be better not to make any changes. Prior to the passage of the Good Roads Law, chapter 115 of the Laws of 1898, it cannot be said that the other highway laws have produced any very satisfactory results to anybody. There are too many laws relating to the subject, rendering it very complex. It could and should be simplified. There are four features of the last Good Roads Law that should be modified, but perhaps another year's experience would prove valuable before making these changes, which are as follows:

(a). The present law does not provide any means of changing the plans and specifications after a contract has been awarded. If any considerable amount of work is to be done, numerous occasions will probably arise where such changes will be absolutely necessary for the best interests of all concerned.

(b). The present law provides that where a change of route is necessary, the right of way for the same must be acquired by the local authorities before the work can proceed, and presumably before the contracts can be awarded. In many cases this will undoubtedly lead to a tedious and useless delay. Would it not be better to provide for the taking of such lands in the same manner as is now done with lands required for canal purposes, leaving the settlement to be made either by the local authorities as at present or by a method similar to that prescribed for the canal cases?

(c). The present law provides that the State Engineer shall hold a meeting for the discussion of highway improvement mat-

ters at least once in each year in each county. As already stated, it has been impossible, under the circumstances, to comply with this provision during the past year. It is believed that the same time and money spent on proper literature would reach a vastly larger number of our citizens, who could thus have the information and facts before them for continued contemplation and guidance. If this method is to be followed a special fund should be available for printing and postage.

(d). Probably the most serious defect in our highway laws, and especially in the law under discussion, is that no proper provision is made for the sure and proper maintenance, especially of those roads which are to be constructed with State aid. If the State spends its money on this work it should be assured that the work will be properly maintained. There is no good reason to believe that after the improved roads have been turned over to the tender mercies of the same authorities who now render our other roads almost impassable at least once a year, that the same wretched methods of maintenance will not prevail. It should be as much of a crime to ruin a good highway as it is to ruin any other valuable property. It is not believed to be necessary for the State to increase its list of employees to accomplish the desired object. The local highway authorities who will have charge of such maintenance could be selected by the same methods as are now in vogue, but they should be compelled to do the work required of them, especially on roads that have been built with State aid, pursuant to the State Engineer's instructions, and their failure to comply with such instructions should be a misdemeanor, punishable by such methods and to such an extent as to be effective.

Comparatively speaking, however, this whole subject is still in its infancy, and no great harm will result if the proposed changes are delayed another year until it can have had proper and mature deliberation, and the results of the present law are better known and understood.

The following table shows roads which have been surveyed, contracts which have been let and amounts paid on them, and also advertising. The engineering expenses are shown in detail in the reports of the division engineers hereto appended.

NAME OF ROAD.	County.	Paid for advertise-ments.	Amount of contracts.	Paid on contracts.
Lebanon-Pittsfield	Columbia	\$37 50	\$7,200 00	\$2,538 00
Troy and Schenectady	Schenectady	50 00	14,590 00	5,142 98
Nyack and West Nyack	Rockland .....	.....	.....	.....
Buffalo-Hamburg	Erie	34 37	24,750 00	3,155 63
Little Ridge road	Monroe .....	.....	.....	.....
East Avenue road	Monroe	37 50	.....	.....
Troy-Greenbush	Rensselaer .....	.....	.....	.....
Northampton road	Montgomery .....	.....	.....	.....
Massena road	Onondaga .....	.....	.....	.....
Deerfield road	Oneida	36 55	13,806 35	3,209 98
Coleman Hill	Onondaga .....	.....	.....	.....
Cortland Valley road	Onondaga .....	.....	.....	.....
River road	Erie .....	.....	.....	.....
Southport road	Chemung .....	.....	.....	.....
Monroe Avenue road	Monroe .....	.....	.....	.....
Chester-Middletown	Orange .....	.....	.....	.....
Troy-Brunswick	Rensselaer .....	.....	.....	.....
		\$195 92	\$60,346 35	\$14,046 59

The county treasurers of those counties of which contracts have been awarded and the work started have paid on account of those contracts drafts for the following sums, in order to equalize, as nearly as possible from month to month, the payments made by the State and the counties:

Schenectady county, road No. 1.....	\$3,501 60
Erie county, road No. 2.....	2,000 00
Oneida county, road No. 3.....	1,760 31
Columbia county, road No. 4.....	2,052 00
	<hr/>
	\$9,313 91
	<hr/>

The balance of the State appropriation of \$50,000 remaining in the Treasury January 1, 1899, is \$24,225.19.

One-half of all expenses is to be paid by the localities in which work is actually done, pursuant to second or final petition.

As final petitions may not be received for all roads thus far surveyed, it is impossible to say just what part of the above expenditures will be borne wholly by the State.

LAND DEPARTMENT.

Through the past year an unusually large amount of land matters have been considered, including many applications for land under water, the larger part being within the limits of the greater city of New York, owing to the charter of that city becoming operative on the 1st day of January, 1898. The board of docks, through the corporation counsel of New York city, objected to all of those cases presented after the beginning of the present year, and in some cases special objections were presented, and hence much additional labor was put upon the State Engineer, who is a member of the committee to hear remonstrants.

Besides those cases pending at the beginning of the present fiscal year there has been received and disposed of 72 applications for lands under water (24 of which were contested) distributed among 12 counties of the State as follows:

Kings, 27; Richmond, 8; Rockland, 5; Greene, 3; Queens, 16; Westchester, 4; Niagara, 1; Columbia, 1; Albany, 1; Rensselaer, 1; Ulster, 1; Clinton, 1.

Of these applications 64 were for "beneficial enjoyment" and 8 were for "purposes of commerce."

Fifty-five sales of lands have been held, embracing 256 separate parcels, for which \$22,637.67 have been received and paid to the State Treasurer.

The lands sold were in nine counties, distributed as follows: Kings, 81; Richmond, 39; Niagara, 4; Tompkins, 1; Oneida, 9; Rockland, 118; Chautauqua, 3; Cortland, 1.

Good progress has been made in rearranging and placing in bound volumes the miscellaneous land papers filed in this office. These papers consist of maps, surveys and reports of surveyors, and many other papers which have heretofore been indexed only in a general way, and according to the descriptions of the different packages. It was, therefore, almost impossible either to find papers when wanted or even to tell whether or not they were on file. The new index is being so made that every map and paper will be indexed and referred to a volume and page, so it can be readily found, and much time will be saved; besides the certainty of knowing whether the sought-for document is or is not filed in the Department.

A number of those land maps, which were in poor condition from age and use, have been copied and certified, and are now used in lieu of the originals.

The rearranging and indexing of the land papers and the copying of the maps has been done under an appropriation of \$1,000 provided for by chapter 790 of the Laws of 1897, and while good results have been obtained for the amount expended, an additional appropriation will be necessary to complete the work in a proper manner. This was thoroughly understood when the present appropriation was made. Future appropriations should be made not only to complete the work, but to provide fireproof safes for the storage of these documents, which are invaluable, and which, once destroyed, could not be duplicated at any cost.

SURVEYS OF OYSTER LANDS.

On the advice of Governor Morton, the surveys of the oyster lands of the State in the vicinity of Long Island and Greater New York, which had theretofore been carried on under the supervision of the Fisheries, Game and Forest Commission, were entrusted to this Department, and since that time the work has been under the immediate charge of Charles Wyeth. The work consists of the surveying and mapping of these lands under water and preparing the necessary papers connected with the leasing of such lands. The Fisheries, Game and Forest Commission, through the efficient management of one of its members, Shell-fish Commissioner Edward Thompson, has carefully managed and fostered this growing industry, which now provides a means of livelihood for a very large class of sturdy, worthy citizens. The plats of land leased vary in area from 1 to 10 acres. The principal sections now under cultivation and requiring engineering attention are in Jamaica, Raritan and Sheepshead bays. In Jamaica bay 484 lots are now leased; in Raritan bay 924 lots are leased. The extent of oyster territory covered by maps in

three sections of Jamaica and Sheepshead bays, in the counties of Kings and Queens, is about 15 miles east and west by 5 miles north and south. That of Raritan bay is about 8 miles east and west and from 1 to 4 miles north and south.

Scattered over this territory there were surveyed and leased during the last fiscal year and to the present time 228 plats of varied contour and boundary. These surveys required the preservation and renovation of many of the U. S. C. S. signals and the reconstruction of many others belonging to the State Fisheries surveys. These signals extend along the shores bordering the oyster territory, and on them depends the location and survey of the grounds.

Owing to weather conditions and rough water it is impossible to do any of the surveying work during the greater portion of the year. These surveys are made during the propitious season, and the balance of the time is spent in platting and computing the field work and arranging data for the issue of leases.

During the past year, in addition to the usual work, a map of that portion of Jamaica bay lying in Queens county covering the eastern half of the bay has been prepared. In addition to this work the surveys have been started of the territory from Port Jefferson to and including Plum island, Long Island sound. For this work it has been necessary to build ten signals in addition to those of the U. S. C. S. between Mount Sinai and Horton's Point, and these, with other natural objects and the U. S. C. S. monuments, make forty signals for the location of oyster grounds along this coast. For this work the system of 1,000-acre townships has been followed, these to be subdivided into quarter sections or 110-acre lots, as the same may be applied for. Two of these sections, covering the coast line and contiguous oyster territory

between Mattituck Hills and Rocky Point, a distance of about 15 miles, have been completed. This section covers the natural oyster beds at Horton's Point.

In the long stretches of coast line between Mattituck Hills and Mount Sinai provision should be made for the further construction of signals, as the coast is entirely devoid of natural objects which could be used for that purpose. Many of the signals or monuments heretofore erected now require renovation, particularly between Port Jefferson and Matinicock Point.

In the work of surveying Jamaica bay we have been assisted by Mr. W. J. Tillotson without cost to the State, he receiving his pay from the oyster men of that locality.

Applications are constantly being made for additional plats of these oyster lands and fourteen such applications are now pending. The preparation of the leases, as well as the surveys and mapping of the lands, seems to require the services of an engineer, and I believe the work should be continued during the coming season in substantially the same manner as heretofore and with a similar appropriation.

The advantages accruing to the State by the fostering of the oyster industry are manifold. The State is reimbursed for the money it expends on this work both directly and indirectly.

Engineering Expenses for the Fiscal Year.
ORDINARY REPAIR FUND.

DIVISION.	CANALS.					Total.
	Erie.	Champlain.	Oswego.	Black River.	Cayuga and Seneca.	
Eastern.....	\$7,553 62	\$3,951 79	.....	.....	.....	.....
Middle.....	4,579 45	.....	\$282 89	\$923 44	\$501 48	.....
Western	8,473 80	.....	.....	.....	.....	.....
	\$20,606 87	\$3,951 79	\$282 89	\$923 44	\$501 48	\$26,266 47

SPECIAL APPROPRIATIONS.

Examination, monuments and maps disbursed by division engineers, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.....	\$6,681 06
Examination, monuments and maps paid directly by State Treasurer, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.....	3,345 37
Geological survey New York State, chapter 391, Laws of 1897, and chapter 219, Laws of 1898.....	23,817 30
Making surveys and maps for the use of the State Board of Claims, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.....	5,946 73
Surveying, plotting and monumenting lands to be leased in the future for oyster industry, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.	2,212 38
To repair and preserve the highway known as the "State Road" in the town of Colton, St. Law- rence county, chapter 606, Laws of 1898.....	2,000 00
Westchester County shore line maps, chapter 950, Laws of 1896.....	1,547 14
Copying and preserving old maps, survey notes and miscellaneous records of this office, relating to lands and land patents of Colonial and early State times, chapter 790, Laws of 1897.....	569 20
For the surveying and mapping of certain oyster lands under waters of Long Island Sound, chapter 704, Laws of 1897.....	403 34
Total.....	<hr/> \$46,522 52 <hr/>

EXTRAORDINARY CANAL IMPROVEMENT.

EASTERN DIVISION.

Erie canal, chapter 947, Laws of 1896, chapter 566, Laws of 1897, and chapter 506, Laws of 1898.....	\$3,350 36
Champlain canal, chapter 947, Laws of 1896; chap- ter 566, Laws of 1897, and chapter 506, Laws of 1898	3,212 58
Improvement Erie canal, chapter 79, Laws of 1895, chapter 794, Laws of 1896, and chapter 43 and 569, Laws of 1897.....	65,483 95
Improvement Champlain canal, chapter 79, Laws of 1895, chapter 794, Laws of 1896 and chapter 43 and 569, Laws of 1897.....	30,872 69
Rebuilding Rexford Flats Dam, chapter 560, Laws of 1895, chapter 947, Laws of 1896, and chapter 566, Laws of 1897.....	917 72
Fourth street bridge, Waterford, chapter 575, Laws of 1897	291 09
Ship street bridge, Cohoes, chapter 778, Laws of 1897.....	419 60
Railroad street bridge, Ilion, chapter 105, Laws of 1897	397 55
Gorman street bridge, Little Falls, chapter 680, Laws of 1895.....	27 98
River street bridge, Fort Plain, chapter 576, Laws of 1897	141 45
Glen street bridge, Glens Falls, chapter 798, Laws of 1896	81 92
Maple street bridge, Sandy Hill, chapter 286, Laws of 1895, and chapter 795, Laws of 1896.....	156 50

Canajoharie bridge, Canajoharie, chapter 592, Laws of 1894, and chapter 562, Laws of 1897....	\$349 36
Cemetery culvert, Waterford, chapter 215, Laws of 1896	74 89
Culvert over weigh lock outlet, Waterford, chapter 364, Laws of 1896	77 65
Basha's Kill Stream, chapter 621, Laws of 1898....	166 60
Draw bridge over Minisceongo creek, chapter 631, Laws of 1898	130 29
Washington Monument Headquarters, Newburgh, chapter 790, Laws of 1897, chapter 606, Laws of 1898	10 74
State road, town of Colton, St. Lawrence county, chapter 606, Laws of 1898	1,999 10
State road, St. Regis Reservation, chapter 932, Laws of 1895	130 62
Shinnecock and Peconic canal (piling and protect- ing), chapters 950, Laws of 1896, chapter 791, Laws of 1897	526 31
Shinnecock and Great South Bay (dredging), chap- ter 207, Laws of 1898	840 84
Sea wall at Orient, chapter 838, Laws of 1895	23 80
Building dyke, Neversink river, town of Deerpark, chapter 291, Laws of 1897	296 59
Rebuilding Saranac dam, chapter 627, Laws of 1898.	703 15
IMPROVEMENT PUBLIC HIGHWAYS, CHAPTER 115, LAWS OF 1898.	
Troy and Schenectady turnpike	576 92
Lebanon and Pittsfield road	608 87
Nyack to West Nyack road, Rockland county	325 34

STATE ENGINEER AND SURVEYOR.

35

Troy and Greenbush road.....	\$234 88
Northampton road, Montgomery county.....	78 36
Chester to Middletown road, Orange county.....	400 49

SPECIAL SURVEYS.

Making surveys and maps for use of State Board of claims, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.....	5,946 73
Making surveys and maps required by State Engineer and Surveyor, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.....	6,681 06
Maps shore line, Westchester county, chapter 950, Laws of 1896.....	1,547 14.
Geological survey, New York State, chapter 320, Laws of 1897, and chapter 219, Laws of 1898....	23,817 30
Total	<u>\$162,405 83</u>

MIDDLE DIVISION.

Repairs to Owasco Lake outlet.....	\$257 01
Whitesboro street bridge at Utica.....	1,093 50
Broad street bridge at Utica.....	1,181 83
Extraordinary repairs	1,448 05
Salina street bridge, Syracuse.....	1,929 37
Washington street bridge, Utica.....	300 00
Schuyler street bridge, Utica.....	200 00
Extraordinary repairs, Erie canal.....	3,500 00
Surveys account Attorney-General	360 00
Bridge over the Oswego canal at Fulton.....	1,200 00
Rebuilding locks, Black river canal.....	2,594 60
Improving Cayuga and Seneca canal at Waterloo..	278 17

Dredging Cayuga and Seneca canal at Geneva.....	\$600 00
Repairing dam at Waterloo.....	220 00
Ditch between Seneca Falls and Waterloo.....	235 00
Removal of bars in Cayuga and Seneca canal at Cayuga.....	202 11
Improvement of public highways.....	892 56
Improvement of the Erie canal.....	112,724 62
Improvement of the Oswego canal.....	12,316 98
Total.....	<u>\$141,533 80</u>

WESTERN DIVISION.

Ordinary repairs	\$8,473 80
Monroe avenue bridge, Rochester.....	1,408 63
Exchange street bridge, Rochester.....	2,701 92
Waste weirs at Lockport, Middleport and near Mabie's bridge	1,034 51
Deepening and improving Eighteen-mile creek....	1,082 79
Culverts Nos. 78 and 94.....	162 02
Culverts Nos. 42, 43, 45 and 56.....	90 00
Erie street bridge, Buffalo.....	650 00
Bridge over Oak Orchard Creek feeder, Medina....	578 45
Bridge over canal feeder at Medina.....	129 82
State Court of Claims.....	1,488 79
Improving channel leading from State culvert un- der Erie canal at Brockport.....	271 50
Culverts Nos. 1 and 2.....	1,865 58
Fitzhugh street bridge, Rochester.....	712 50
South Clinton street bridge, Rochester.....	483 62
Deepening and improving Cayuga creek.....	316 45
Deepening and improving Mud creek.....	467 44

Bridge over Allegany river between Carrollton and Allegany	\$62 41
Removing obstructions, etc., Chemung river, at Corning	411 17
Dredging Bear lake	74 85
Protecting unfinished work under general improvement	807 83
Southport road, Chemung county	20 40
Enlarging spillway, Cuba reservoir	72 74
Improving Glen creek, Watkins	143 28
Buffalo-Hamburg road, Erie county	857 58
Ridge road, Monroe county	688 63
East avenue road, Monroe county	369 44
River road, Erie county	127 99
Improving Newtown creek	367 95
Dike along Chemung river, Elmira	251 11
Hamilton street bridge, Buffalo	525 85
Improvement of highway, Allegany Indian Reservation	130 54
Improvement of highway, Tonawanda Indian Reservation	99 51
Lift bridge at Brighton	558 35
New Home bridge	67 70
Canal improvement, Erie canal	79,574 18
Total	<u>\$107,129 33</u>

Table of Contracts Pending on the New York State Canals on the 30th day of September, 1898.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	LEGISLATIVE ACT.		Appropriation.	Engineer's estimate.	Engineer's estimate at contract prices.	Payments to date.
			Chapter.	Year.				
Rochester Bridge & Iron Works	Nov. 16, 1896		{ 680	1896	42,000 00	{ 97,104 50	97,445 48	96,035 00
Hilton Bridge Construction Co.	July 20, 1897		{ 572	1897	4,046 50	{ 15,889 00	13,678 20	11,781 00
Whalen & Higgins	Sept. 14, 1897		{ 105	1897	18,000 00			
P. J. Brummelkamp	Aug. 28, 1897		{ 947	1898	9,424 00	{ 29,218 00	25,981 50	25,100 00
Lauer & Hageman	Nov. 17, 1896		{ 566	1897	7,644 00			3,325 00
			{ 572	1897	13,149 43			
			{ 791	1897	Agreement.....			
		Repairs to Shinnecock and Peconic canal.						
		For the improvement of the Eastern Division of the Erie canal from lock 27 to lock 28, a distance of 5.21 miles	{ 79	1895	9,000,000 00	76,028 00	74,159 35	118,423 00
			{ 794	1896				
			{ 43 & 508	1897				
Brummelkamp, Lane & Co.	Nov. 16, 1896	For the improvement of the Eastern Division of the Erie canal from lock 32 to lock 33, a distance of 5.11 miles	{ 79	1895	9,000,000 00	80,532 65	58,424 85	119,700 00
			{ 794	1896				
			{ 43 & 509	1897				
Lauer & Hageman	Nov. 17, 1896	For the improvement of the Eastern Division of the Erie canal from lock 33 to lock 34, a distance of 2.57 miles	{ 79	1895	9,000,000 00	45,000 50	43,831 25	59,979 00
			{ 794	1896				
			{ 43 & 509	1897				
Mahon and Sundstrom	Nov. 12, 1896	For the improvement of the Champlain canal between lock 15 and lock 16, a distance of 11.75 miles	{ 79	1895	9,000,000 00	245,188 75	214,317 53	219,375 00
			{ 794	1896				
			{ 43 & 509	1897				
John V. Quackenbush	Sept. 21, 1896	For the improvement of the Eastern Division of the Erie canal from lock 45 to the east line of Oneida county, a distance of 8.77 miles	{ 79	1895	9,000,000 00	225,326 00	181,998 00	74,675 26
			{ 794	1896				
			{ 43 & 509	1897				
Troy Public Works Company.	Sept. 16, 1897	For the improvement of the Eastern Division of the Erie canal from lock 26 to lock 27, a distance of 6.59 miles	{ 79	1895	9,000,000 00	149,220 00	132,978 00	92,979 00
			{ 794	1896				
			{ 43 & 509	1897				
Lauer & Hageman	Oct. 12, 1897	For the improvement of the Eastern Division of the Erie canal from lock 24 to lock 25, a distance of 3.8 miles	{ 79	1895	9,000,000 00	91,908 00	97,301 00	76,420 70
			{ 794	1896				
			{ 43 & 509	1897				

Clinton Beckwith.....	Sept. 21, 1897	For the improvement of the Eastern Division of the Erie canal from lock 40 to lock 41, a distance of 1.64 miles	79 1895 794 1896 43 1897 569 1897 506 1896	9,000,000 00	69,208 50	52,908 00	12,545 00
John V. Quackenbush	Sept. 21, 1897	For the improvement of the Eastern Division of the Erie canal from lock 41 to lock 42, a distance of 2.85 miles	79 1895 794 1896 43 1897 569 1897 506 1896	9,000,000 00	72,458 50	59,399 50	86,189 00
Clinton Beckwith.....	Sept. 21, 1897	For the improvement of the Eastern Division of the Erie canal from lock 39 to lock 40, a distance of 2.78 miles	79 1895 794 1896 43 1897 569 1897 506 1896	9,000,000 00	94,480 00	69,839 00	62,912 50
Pulford & Compton.....	Nov. 3, 1897	For the improvement of the Champlain canal from lock 20 to lock 21, a distance of 5.44 miles	79 1895 794 1896 43 1897 569 1897 506 1896	9,000,000 00	85,579 00	64,249 50	36,397 00
Baker, Barker, Hingston & Co.	Nov. 11, 1897	For the improvement of the Champlain canal from lock 17 to lock 20, a distance of 6.8 miles.....	79 1895 794 1896 43 1897 569 1897 506 1896	9,000,000 00	38,294 00	24,017 00	18,435 00
E. W. Wicks	June 14, 1896	For dredging the canal between Shinnecock and Great South Bay, town of Southampton, county of Suffolk, N. Y.	207 1896 571 1897 568 1897 505 1897 79 1896	10,000 00	8,500 00	5,440 00	2,448 00
Groton Bridge & Mfg. Co	Feb. 24, 1896		571 1897		25,435 00	20,021 50	23,967 00
Groton Bridge & Mfg. Co	Feb. 24, 1896		568 1897		725,567 00	18,894 50	10,574 00
Havana Bridge Works	Feb. 23, 1896		505 1897		22,815 50	13,480 38	11,781 00
McDonald & Bayre	Nov. 17, 1896	Contract No. 2	79 1896 794 1896 43 1897 569 1897 506 1896	9,000,000 00	203,772 00	142,948 30	269,409 00
John Dunfee & Co	Nov. 14, 1896	Contract No. 3	79 1896 794 1896 43 1897 569 1897 506 1896	9,000,000 00	142,798 00	126,842 90	215,126 00
John Dunfee & Co	Nov. 14, 1896	Contract No. 4	79 1896 794 1896 43 1897 569 1897 506 1896	9,000,000 00	155,403 00	154,741 00	544,165 00
John Dunfee & Co	Nov. 14, 1896	Contract No. 5	79 1896 794 1896 43 1897 569 1897 506 1896	9,000,000 00	156,614 00	151,618 00	217,358 00
O'Brien & Heollhan	Mar. 18, 1897	Contract No. 18	79 1896 794 1896 43 1897 569 1897 506 1896	9,000,000 00	90,873 00	91,794 50	187,506 00

* The city of Syracuse pays \$12,000 for Salina street bridge; this includes substructure and superstructure.

† The city of Utica pays \$10,000 for Whitesboro street bridge; this includes substructure and superstructure.

‡ The city of Utica pays \$5,000 for Broad street bridge; this includes substructure and superstructure.

Table of Contracts Pending on the New York State Canals, Etc. — (Continued.)

NAME OF CONTRACTOR.	Date of contract.	Character of work.	LEGISLATIVE.		Appropriation.	Engineer's estimate.	Engineer's estimate at contract prices.	Payment to date.
			Chapter.	Year.				
O'Brien & Hoolihan	Mar. 19, 1897	Contract No. 19	{ 79 1895 43 & 569 1896 1897		\$9,000,000 00	\$106,322 50	\$105,053 50	\$182,367 00
Warren-Scharff Asp. Pav. Co. .	Aug. 17, 1897	Contract No. 20	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	246,653 00	242,757 55	68,940 00
Warren-Scharff Asp. Pav. Co. .	Aug. 17, 1897	Contract No. 21	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	218,247 00	212,945 45	53,496 00
National Contracting Co.	Aug. 6, 1897	Contract No. 22	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	247,465 00	232,307 50	170,289 00
E. H. Gaynor	Aug. 23, 1897	Contract No. 23	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	165,897 00	147,582 00	134,649 00
National Contracting Co.	Aug. 6, 1897	Contract No. 24	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	142,051 00	136,720 00	101,106 00
National Contracting Co.	Aug. 6, 1897	Contract No. 25	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	140,680 00	127,750 00	98,946 00
John Danfee & Co	Aug. 5, 1897	Contract No. 26	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	145,452 00	136,600 00	240,840 00
Willoughby B. Priddy	Aug. 18, 1897	Contract No. 27	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	125,869 00	115,713 00	200,466 00
Andrew Onderdonk	Aug. 19, 1897	Contract No. 28	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	172,430 00	167,216 00	116,703 00
Rochester Bridge & Iron W'ks.	Nov. 13, 1897	Contract No. 47	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	12,425 00	13,289 25	12,654 00
Dodge & McGregor	Dec. 8, 1896	Contract No. 6	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	14,497 60	12,206 00	13,158 00
John Kelly & Co	Nov. 16, 1896	Contract No. 7	{ 79 1895 794 1896 43 & 569 1897		9,000,000 00	12,618 00	10,695 00	5,130 00

John Kelly & Co	Nov. 16, 1896	Contract No. 8	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	15,333 00	13,425 50	8,991 00
John Kelly & Co	Nov. 16, 1896	Contract No. 9	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	20,049 00	17,801 00	14,166 00
Hughes Bros. & Bange	Nov. 20, 1896	Contract No. 10	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	48,653 00	51,370 50	42,678 00
Kirk, Driscoll & Co	Dec. 20, 1897	Contract No. 34	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	136,895 00	126,655 00	71,514 00
Willard Johnson ..	Aug. 11, 1897	Contract No. 37	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	13,836 00	15,382 00	10,773 00
Walter Bradley	Dec. 27, 1897	Contract No. 46	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	16,860 00	12,636 50	702 00
W. A. Gillette	Oct. 9, 1897	Improving Cayuga Creek	{ 569 1897	5,000 00	4,380 00	2,870 00	3,420 00
Rochester Bridge & Iron W'ks.	July 8, 1898	Fitzhugh street lift bridge, Rochester	{ 32 1897 606 1898	20,000 00	25,969 75	23,931 50	000
Rochester Bridge & Iron W'ks.	Mar. 12, 1898	So. Clinton street lift bridge, Rochester	{ 339 1897	20,000 00	19,729 50	15,862 00	6,520 00
B. P. Smith	Mar. 10, 1898	Monroe avenue lift bridge, Rochester	{ 207 1897	32,000 00	29,701 65	25,494 00	22,240 00
Buffalo Dredging Co	Feb. 24, 1898	Hamilton street lift bridge, Buffalo	{ 607 1898	4,000 00	4,000 00	7,497 00	6,540 00
John Calnan	Jan. 10, 1898	Repairing and rebuilding culverts 42, 43, 45 and 56	{ 568 1897	10,000 00	8,053 00	8,860 15	6,280 00
Buffalo Dredging Co	Nov. 4, 1896	Contract 2, Western Division	{ 568 1897 79 1895 794 1896 43 & 569 1897	9,000,000 00	287,834 00	291,686 25	444,210 00
Chas. T. Parker & Co	Nov. 7, 1896	Contract 3, Western Division	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	312,510 00	188,541 75	88,060 00
Grannis & O'Connor	Jan. 23, 1897	Contract 5, Western Division	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	227,102 00	217,119 50	276,192 27
Furnaceville Iron Co	Sept. 23, 1897	Contract 6, Western Division	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	166,090 00	165,800 00	61,600 00
Baker & Banker	Sept. 3, 1897	Contract 7, Western Division	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	99,725 00	98,760 00	75,140 00
Williams, McNaughton & Babst	Sept. 21, 1897	Contract No. 8, Western Division	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	191,090 00	184,695 00	82,730 00
Furnaceville Iron Co	Sept. 23, 1897	Contract No. 9, Western Division	{ 79 1895 794 1896 43 & 569 1897	9,000,000 00	114,440 00	111,000 00	80,190 00

Table of Contracts Pending on the New York State Canals, Etc.—(Continued.)

NAME OF CONTRACTOR.	Date of contract.	Character of work.	LEGISLATIVE.		Appropriation.	Engineer's estimate.	Engineer's estimate at contract prices.	Payment to date.
			Chapter.	Year.				
Furnaceville Iron Co	Sept. 23, 1897	Contract No. 10, Western Division.....	{ 79 48 & 569	1895 1896 1897	{ \$9,000,000 00	{ \$152,000 00	{ \$185,500 00	{ \$38,420 00
Furnaceville Iron Co	Sept. 23, 1897	Contract No. 11, Western Division.....	{ 79 43 & 569	1895 1896 1897	{ 9,000,000 00	{ 116,385 00	{ 110,100 00	{ 57,558 68
Furnaceville Iron Co	Sept. 23, 1897	Contract No. 12, Western Division.....	{ 79 43 & 569	1895 1896 1897	{ 9,000,000 00	{ 96,540 00	{ 87,000 00	{ 31,310 00
Henry C Allen & Co.....	Sept. 18, 1897	Contract No. 13, Western Division.....	{ 79 43 & 569	1895 1896 1897	{ 9,000,000 00	{ 119,727 50	{ 105,850 00	{ 78,160 00
Whitmore, Rauber & Vicinus.	Sept. 20, 1897	Contract No. 14, Western Division.....	{ 79 43 & 569	1895 1896 1897	{ 9,000,000 00	{ 169,830 60	{ 159,695 00	{ 89,730 00
Whitmore, Rauber & Vicinus.	Sept. 20, 1897	Contract No 15, Western Division.....	{ 79 43 & 569	1895 1896 1897	{ 9,000,000 00	{ 90,915 00	{ 88,595 00	{ 84,160 00

Final Account Passed in this Office During the Fiscal Year Ending September 30, 1898—(Concluded).

Number	CHARACTER OF WORK.	Name of contractor.	Engineer's estimate at contract prices.	Amount of final account.
24	Completing repairs, etc., at Owaseo lake outlet and constructing a wall of rubble masonry at foot of Owaseo lake	John J. Hallock	\$16,509 00	\$19,957 48
25	..... Higginsville, N. Y.	Wroughts Iron Bridge Co.	3,512 00	3,439 31
26	..... and Seneca canal at Montezuma	.....	5,400 00	3,913 56
27	.....	.....	15,785 00	16,137 64
28	..... streets, village of Fulton	.....	15,785 00	19,281 47
29	.....	John J. Hallock	12,750 00	2,774 61
30	Constructing a steel bulkhead at Waterloo dam	Robbester Bridge and Iron Works	28,215 00	24,960 96
31	Contract No. 1, improvement of the Erie canal	Havana Bridge Works	1,511 00	1,145 17
32	Contract No. 13, improvement of the Erie canal	T. J. Dwyer & Co.	203,420 00	301,155 15
33	Contract No. 15, improvement of the Oswego canal	Hughes Bros. & Hange	10,198 50	16,983 15
34	Contract No. 36, improvement of the Oswego canal	Walter Bradley	66,144 00	81,180 96
35	Building culvert for Oak Orchard creek, Medina	Edwin Lodder	51,057 00	55,324 38
36	..... in creek	Williams, McNaughton & Bapat	6,418 73	6,119 60
37	..... Nos 1 and 2	.....	3,280 00	3,189 12
38	..... g Chemung river at Elmira	.....	10,696 00	27,215 67
39	Removing dam across Chemung river at Corning	W. A. Gillette	3,404 00	3,402 83
40	Rebuilding Leckport and Mables wastewells	Charles A. Gorman	4,090 00	4,242 51
41	Exchange street lift bridge, Rochester, N. Y.	Chambers & Casey	3,444 50	12,189 52
42	Rebuilding and repairing culverts Nos. 78 and 94	Martin & Barlow	41,337 06	46,545 74
43	Improving Mud creek	Frank J. LeValley	4,554 00	5,419 86
44	Contract No. 1	Donnelly Contracting Co.	11,325 06	13,323 34
45	.....	.....	433,325 00	636,989 87

* The city of Rome paid \$3,500 for Garden street bridge; this includes substructure and superstructure. † This amount includes construction of State ditch between Waterloo and Seneca Falls. ‡ The towns of Lysander and Clay paid \$1,500 as their share.

SUMMARY.

Ordinary repairs	\$26,306 47
Extraordinary canal improvement	411,068 86
Special appropriations	46,522 52
Total engineering expenses	<u>\$483,897 79</u>

TOPOGRAPHIC SURVEY OF THE STATE.

DEPARTMENT OF THE INTERIOR,

UNITED STATES GEOLOGICAL SURVEY,

WASHINGTON, D. C., *November 17, 1898.*Hon. C. W. ADAMS, *State Engineer and Surveyor, Albany, N. Y.:*

Sir.—I have the honor to make herewith a preliminary statement of the work done under the agreement signed April 14, 1898, by you on behalf of the State of New York and by me on behalf of the United States Geological Survey.

By the terms of that agreement twenty-five thousand dollars (\$25,000) was allotted by you for expenditure in making the co-operative topographic survey therein provided for. In addition there remained at the beginning of the field season an unexpended balance of the State appropriation of 1897 amounting to four thousand six hundred and fifteen dollars and twenty cents (\$4,615.20), making thus a total of twenty-nine thousand six hundred and fifteen dollars and twenty cents (\$29,615.20) of State funds available for this co-operative survey. This Bureau has, under the terms of the agreement, allotted a like amount to this work, less the sum of five thousand two hundred and seventy-four dollars and twenty cents (\$5,274.20) expended in 1897 in excess of the amount agreed upon to be allotted to meet your co-operative appropriation of fifteen thousand dollars (\$15,000). Accordingly, there was available for topographic surveys within the State of New York during the field season of 1898 the total of the State funds, twenty-nine thousand six hundred and fifteen dollars and twenty cents (\$29,615.20), and the Federal funds, twenty-four thousand two hundred and forty-one dollars (\$24,241), or fifty-three thousand eight hundred and fifty-six dollars and twenty cents (\$53,856.20).

The net result of the field work resulting from the expenditure provided under this agreement has been the making of an accurate trigonometric survey for the control of future topographic field work of an area of two thousand eight hundred and fifty

(2,850) square miles within the State, at an expenditure of one thousand seven hundred and ninety-five dollars (\$1,795) for field work only, or at the average cost of sixty-three (63) cents per square mile. This triangulation furnishes control of the future mapping of ten additional atlas sheets in central New York and in the Adirondacks. Moreover, there have been run the entire length of the State of New York, near its southern border, from Cohoes to Dunkirk, 440 miles of precise levels, by which elevations of 488 different points have been determined, as referred to mean sea level, with such accuracy that they are scarcely likely to be changed within a generation at least. All these elevations have been permanently marked, while sixty-three of them have been most substantially marked by bronze and aluminum tablets set in masonry. The total cost of this precise leveling was two thousand one hundred and fifty-five dollars (\$2,155), or at the average rate of four dollars and eighty-seven cents (\$4.87) per linear mile, a sum unusually small for such high-grade work.

In addition to the above work for the primary control of future surveys there has resulted from the field operations of the past season a complete and accurate topographic map on a scale of 1:62,500 of approximately one mile to one inch and with a contour interval of 20 feet, of three thousand three hundred and ninety-seven (3,397) square miles within the State of New York.

All of this is original work which will be published on seventeen separate atlas sheets, well distributed through twenty-six different counties in the State. Moreover, secondary elevations by leveling and vertical angulation, traverse for the control and planetable triangulation for control of five additional atlas sheets has been completed, so that these five sheets may now be considered more than half surveyed.

The total cost of the topographic field work was thirty-three thousand one hundred and seventy dollars (\$33,170), or, for that portion of it which is finished, at the rate of eight dollars and ninety-four cents (\$8.94) per square mile, mapped, a sum twenty-four cents (\$0.24) in excess of the expenditure of the pre-

vious field season, due, in part, to the exceeding unfavorable atmospheric conditions which prevailed during the past summer.

The total cost of all of the above work, including topography, triangulation and precise leveling, and including estimated expenses for platting the computations and drafting maps in the office during the coming winter is forty-eight thousand seven hundred dollars (\$48,700). No average rate per square mile can be safely given for this, as the above sum includes triangulation, precise leveling and partially surveyed sheets. Of the above sum approximately twenty-six thousand dollars (\$26,000) has already been expended by the State and fifteen thousand dollars (\$15,000) by the Federal Government, and the greater portion of the remainder will be expended by this Bureau, as in the past, in meeting the office expenses connected with this work.

As the total joint allotment to this work was fifty-three thousand eight hundred and fifty-six dollars and twenty cents (\$53,856.20), and the total expenses, including estimates for office work, forty-eight thousand seven hundred dollars (\$48,700), there will remain a balance of State and Federal money at the beginning of the next field season of 1899 approximating four thousand one hundred and fifty-six dollars (\$4,156). This sum will be devoted, as in the past spring, to the early inauguration of field work in the State. With your approval I have, therefore, to suggest that this sum be devoted to the completion of the topographic mapping of the five partially surveyed sheets, namely: Sodus bay, Lyons, Weedsport, Chemung and Morrisville, and, if any balance still remains, to the survey of such other areas as you may designate.

Very respectfully,

CHAS. D. WALCOTT,

Director.

Chapter 219 of the "general laws of 1898" authorized the State Engineer and Surveyor to continue co-operation with the director of the United States Geological Survey in making a

topographic survey and map of the State of New York and appropriated for this work the sum of twenty-five thousand (\$25,000) dollars. In addition there remained available for field work during the field season of 1898 an unexpended balance of four thousand six hundred and fifteen dollars and twenty cents (\$4,615.20) of the appropriation of fifteen thousand dollars (\$15,000) made by chapter 320 of the "general laws of 1897," making a total of twenty-nine thousand six hundred and fifteen dollars and twenty cents (\$29,615.20) of State funds available for these topographic surveys.

In accordance with the provisions of the Law of 1898, above quoted, an agreement was signed by the Hon. Charles D. Walcott, director of the United States Geological Survey, and myself which is similar in all essential details to agreements made in former years between this office and the United States Geological Survey and published in my previous annuals. As a result the Federal Survey allotted to this work the sum of twenty-four thousand two hundred and forty-one dollars (\$24,241), but it was unnecessary for them to appropriate a sum sufficient to meet the balance from our appropriation of 1897, as the Federal Survey had in 1897 expended fifteen thousand six hundred fifty-nine dollars (\$15,659) on this work, being an amount which was five thousand two hundred and seventy-four dollars and twenty cents (\$5,274.20) in excess of the expenditure in that year by this office. Accordingly there was available for topographic surveys within the State of New York during the season of 1898 a total sum of fifty-three thousand eight hundred and fifty-six dollars and twenty cents (\$53,856.20).

Hereto I append descriptions and positions of a few of the primary triangulations located in the prosecution of this work

during the previous season of 1897, the final positions of these points not having been computed in time for insertion in my last annual report. I also append a list of benchmarks established in the running of a line of precise levels between the coast survey datum at Albany via Binghamton and Elmira to the United States Engineer's benchmark at Dunkirk on Lake Erie. I do not append to this report the positions of triangulation stations located during the field season of 1898 nor the lists of general elevations determined by spirit leveling during the same season for the reason that it appears to me undesirable to further burden the publications of the State and its treasury with the recital of dry lists of figures which are published annually in the reports of the United States Geological Survey, and can be obtained therefrom by those who may wish to refer to them. I commend this report and the accompanying progress map and diagrams of triangulation to your careful attention and consideration and feel convinced that after its perusal you will not fail to appreciate the efficient and economic progress which has been made toward the completion of a credible topographic survey of the State.

PLANS.

Prior to the signing of the co-operative agreement above cited and after consultation with Mr. H. M. Wilson, geographer of the United States Geological Survey in charge of topographic surveys on the Atlantic slope, it was decided to at once resume field work with the balance remaining unexpended from the appropriation of 1897, but to so plan as to admit extension of the work commenced and on lines which would involve the expenditure of the larger amount which was finally appropriated. These plans were similar to those arranged during the previous years

of my administration, in order to throw the most light on the problems of additional water supply for the State canals by mapping the country contiguous to them, as well as the adjacent territory included within the watersheds from which such additional supply might be drawn. In addition, as heretofore, a limited amount of work was done without the areas of the watershed of the State canals in order that other portions of the State might receive that encouragement to the development of their latent resources which their needs demanded and in order that the territory contributory to the State canals should not alone benefit from this work. In the latter category a large portion of Chautauqua and adjacent portions of Cattaraugus and Erie counties were surveyed in order that topographic maps might be available along the region bordering upon the international boundary, both for the benefit of lake navigation and at the request of the State military authorities.

The existing gap remaining in the topographic surveys along the route of the Erie canal between Rochester and Syracuse was planned to be completely filled by the the surveys of this season. Also the gap on the same canal along the drainage of the Mohawk river between Fonda and Herkimer. In like manner it was planned to survey the only break in the compact series of topographic maps which cover the route of the Champlain canal, being that in the neighborhood of Schuylerville. In seeking for a water supply for the middle levels of the Erie canal, it was deemed desirable to at once survey the drainage basins of Cayuga and Seneca lakes, also to continue the topographic surveys on the headwaters of the Canada creeks for the supply of the Black river feeder and the upper Mohawk feeders.

In order that this work might be continued in the future it was necessary to plan the extension of primary triangulation for the control of additional topographic surveys, and such triangulation was planned for the region between Elmira, Auburn and Rochester, covering the entire group of "finger" lakes from Canandaigua to Cayuga. In the interests of the forest preserve it was deemed desirable to extend triangulation in the Adirondacks to the north of the regions already mapped in order that map work might be continued over the forest preserve if necessary. To this end triangulation was extended north of the Fulton chain of lakes so as to control the neighborhood of Tupper and Raquette lakes to the Saranac waters. Finally, that the base elevations on which the topographic map might be accurately reduced to mean sea level, a line of precise levels was run over the general route of the Delaware and Hudson Railroad from Albany to Binghamton and over the Erie railroad from Binghamton to Dunkirk, being connected at one end with the precise benchmark of the Coast Survey and at the other with that of the United States Engineer's.

It was deemed unwise to attempt to complete during the summer season of 1898 all of the work outlined, it being considered more economical to plan and prepare a basis for some future extension of this work in addition to completing a large area of topographic survey, rather than devote all the funds available to topographic mapping and leave the work of the future hampered for lack of proper base control. Accordingly, only so much final topographic surveying was undertaken as could be safely completed during the winter season and in addition control, including plane-table triangulation, spirit leveling and traverse work was obtained for five additional sheets. It will thus be possible

to at once begin topographic work next spring with the least loss of time and least expenditure of money. It is worthy of note that all of the work planned was completed and that there remains a sufficient unexpended balance to permit of the completion of the topographic mapping in the spring of 1899 and prior to the end of the government fiscal year of June next, of the five sheets which have been controlled by triangulation, precise leveling and plane-table triangulation.

TRIANGULATION.

On July 1st Mr. W. T. Griswold, topographer of the United States Geological Survey, assisted by Mr. A. S. Williams, commenced the field work of extending primary triangulation over the Finger lakes region of central New York. He was assigned the duty of furnishing primary locations for the control of a group of eight sheets which were given the provisional names, Canandaigua, Phelps, Waterloo, Naples, Penn Yan, Ovid, Genoa and Hammondsport, these names being derived from the principal villages located within the areas of the sheets. This triangulation was based on several Coast Survey positions established in previous years to the north of the area under survey, namely: Turks, Palmyra and Clyde stations; also on three stations of Gardiner's New York State survey, namely: Urbana, Orange and Newfield. This work was continued for about a month, when it was discontinued in order that Mr. Griswold might execute some triangulation in the Adirondack region during the summer months. Later he returned to this and completed it toward the middle of November. This work resulted in the location of about twenty trigonometrical positions scattered over the various atlas sheets.

During August and September Mr. Griswold was engaged in extending primary triangulation to control the Tupper lake, Long lake and Raquette lake sheets in the Adirondacks. His triangulation was based on the positions Bald, Blue and Kempshell established in 1896 and 1897 by the co-operative topographic survey. The result of this work was the location of eight stations well distributed throughout the atlas sheets to be controlled.

The net result of the triangulation of the field season was the procurement of primary control of an area of about 2,850 square miles. There has thus been furnished trigonometric control for twelve additional atlas sheets which may be mapped in ensuing seasons. For a total expenditure of \$1,795 for the field season there were controlled by triangulation 2,850 square miles, or the average cost of which was 63 cents per square mile. This work fills up two important gaps in the triangulation control of the State, and will permit the topographic mapping in the immediate future of one of the most important feeder regions of the Erie canal as well as of one of the most interesting portions of the State forest reservations.

The observing of angles in the prosecution of the above work was executed with the same high-grade instruments and the same care as has been exercised in the past, as described in my last annual report. Each of the stations occupied by the triangulation party during the past season is permanently marked upon the ground by a dressed granite post, six inches on a side and three and one-half feet in length, in the center of which is imbedded a copper plate. On some of the stations, however, the summits of which are composed of solid rocks, in place, copper bolts were let into drilled holes in this rock. These bolts

are stamped, as explained in my last annual, with the letters "U. S. G. S.—N. Y." and the serial numbers of station. The area controlled by triangulation during this season, added to that previously controlled, gives a total area of 30,850 square miles of the State which is governed by triangulation executed to date.

MERIDIAN MARKS.

In the prosecution of primary triangulation above described there is to be established a meridian mark at each of the county seats included within the area covered by such triangulation. Owing to the unfavorable climatic conditions at the close of the field season these meridian marks have not been placed to date, but will be established early in the spring at Canandaigua, Ovid and Penn Yan. These meridian marks will consist of two dressed granite stones placed in the ground several hundred feet apart on an exactly true north and south line. They will aid county and local surveyors in adjusting their compasses and determining the declination of the compass needle.

PRECISE LEVELING.

Early in May Mr. E. L. McNair, levelman, assisted by Messrs. J. E. Buford and W. F. Hammond, rodmen, commenced the running of a line of precise levels from United States engineers' benchmark near their tidal gauge at Dunkirk. This line ran from the above point over the route of the Erie railroad via Olean, Hornellsville and Elmira to Binghamton, and thence via the line of the Delaware and Hudson railroad through Unadilla, Oneonta and Schenectady to the United States Coast and Geodetic Survey benchmark near Cohoes. The total length of this line, including some test leveling, was 440 miles. Throughout

the length of this line permanent benchmarks were established at distances apart approximating 6 miles. In all 63 of these benchmarks were placed. They consist of the standard bronze or aluminum tablets set in masonry, as described in my last annual, and bearing the names "U. S. Geological Survey—New York," as well as the elevation of the tablet to the nearest foot above mean sea level and other minor inscriptions. In addition, less substantial but fairly permanent benchmarks were placed at about every mile of the route leveled, 425 such being determined. The height of the top of rail of railroad being determined at all important changes of grade, in front of stations, at road crossings, etc. In all there were determined by this line 488 useful elevations, a list of which is published in an appendix attached hereto.

This was a most important piece of precise work if for no other reason than because it established the accuracy of the leveling done in 1875 by the United States engineers, which organization carried a line of precise levels from the Coast Survey bench mark at Albany, via Utica and Rome, to Lake Ontario, thence by water levels through Lake Ontario and to Lake Erie at Dunkirk. On this line of levels has depended all the precise leveling done by the State heretofore as well as precise levels in other States bordering on the Great Lakes. The excellent closure check obtained between that line and the line just run by the co-operative survey proves the quality of both and gives us two belts of precise levels, one along the north central portion of the State and the other along its southern border. On these may now be based all the future accurate leveling which may be done by the co-operative survey and by railroads and private engineers.

Two noteworthy facts connected with this precise leveling are the excellent quality of the results obtained and the remarkable speed with which so exact a piece of work has been performed. The total number of field days occupied in this work were 107, and as the distance run was 440 miles, the average speed was a little over 4 miles per working day. The total cost of this work was \$2,155. Its average cost per mile was, therefore, \$4.87 per linear mile, a sum far below that at which any such high-grade work has ever been run in the past by any official organization. The total divergence between the two double-rodged lines run between Dunkirk and Cohoes was but a couple of tenths of a foot, or far less than the limit of error allowable in such work. The total distance of the closed circuit, including the line of the United States engineers through the lakes, was approximately 800 miles, while the closure error in this circuit was but 0.645 of a foot, or well within the most severe limit of precision established by geodetic surveys of work of similar class, the formula for limit of precision in this case being

$$.016' \sqrt{2 \text{ dist. in miles.}}$$

Attached to the appendix giving the lists of elevations determined by this line of levels, I give a brief description of the methods of conducting the work, as explained by Mr. H. M. Wilson, geographer, in general charge of this work, in a communication presented to the American Society of Civil Engineers.

TOPOGRAPHY.

The field work of topographic surveying was resumed during the past season early in April or a month earlier than usual. The order in which various areas were surveyed was arranged in accordance with plans approved by me at the beginning of the

field season. But that the work might be most economically executed some parties did not survey continuously at all times in the same areas but were shifted from one locality to another during the season as the exigencies of their duties required. The following is a general outline of the work executed under the direction of the individual chiefs:

Mr. Frank Sutton took general charge of the field survey of Westfield, Dunkirk, Villenova and Irving quadrangles assisted by Messrs. J. W. Thom and G. S. Smith. Field work was commenced the 20th of April, and on July 1st Messrs. Sutton and Thom were ordered to other States by the officers of the United States Geological Survey, and Mr. G. S. Smith remained in charge of this work until its completion at the end of September.

Mr. J. H. Wheat had charge of field work of surveying Macedon, Newark, Lyons and Sodus Bay quadrangles from April 10th to November 25th, the close of the season.

Mr. E. B. Clark had charge of field survey of Fulton, Baldwinville, Oswego and Weedsport quadrangles throughout the entire season from April 10th to November 25th. In this work he was assisted for a couple of months by Mr. J. H. McCormick, topographer.

Mr. R. D. Cummin, assisted by Mr. N. G. Van Doren, was in charge of field survey of Watkins, Dryden and Chemung quadrangles from April 25th to October 31st, the close of the season.

Mr. W. H. Lovell was in charge of field survey of Schuylerville and Wilmurt and aided in survey of Little Falls quadrangles from May 1st to November 15th, the close of the season.

Mr. C. C. Bassett had charge of field survey of Schoharie and aided in survey of Canajoharie and Little Falls quadrangles between April 1st and October 31st.

Mr. A. M. Walker had charge of field work on Canada lakes quadrangle from July 1st to November 5th.

Mr. Albert Pike was in charge of field work on Wilmurt quadrangle during the month of June.

Mr. Hersey Monroe was in charge of field work on Little Falls quadrangle from April 1st to June 30th.

Mr. W. L. Miller was in charge of field work on Canajoharie quadrangle from April 20th to June 30th.

Mr. J. H. Jennings was in charge of field work on Morrisville quadrangle during the month of October.

All of the above were aided by one or more field assistants engaged in route traverse and in running spirit levels.

The net result of the field work of the various parties above enumerated is summed up in the following table:

ELEVATIONS.		TRAVERSE.		COST FIELD WORK ONLY.	
M Br.	Per square inch.	Miles, total number.	Per square inch.	Total.	Per square mile.
5	1.7	1,940	3.4	\$8,325	\$5.82
5	1.6	1,725	3.5	3,650	7.51
5	3.1	1,485	2.5	3,670	6.32
5	1.4	1,360	3.1	4,150	9.36
5	1.9	485	2.2	5,520	25.80
5	1.2	245	1.1	2,500	11.26
5	3.2	730	3.3	1,590	7.80
5	2.1	700	3.2	2,580	11.82
5	2.1	565	2.5	1,730	7.90
5	2.5	690	3.1	1,725	7.88
5	.....	9,915	.....	\$30,440	.....
5	0.7	505	.....	450	.....
5	.....	50	.....	55	.....
5	2.7	490	.....	505	.....
5	2.1	650	.....	930	.....
5	1.6	640	.....	790	.....
5	.....	12,240	.....	\$33,170	.....

ing of the area mapped. This leveling was executed

10

An inspection of the above table shows that topographic field work was in active progress during various portions of the season in 26 different counties of the State. There were completely mapped during the season 17 atlas sheets and there were partially mapped 5 other atlas sheets. All together the topographic survey was completed of 3,397 square miles at a total cost for field work alone of thirty thousand four hundred and forty dollars (\$30,440). In addition to this two thousand seven hundred and thirty dollars (\$2,730) was expended on partially surveyed sheets besides the sums on primary triangulation and spirit leveling. The balance will be expended during the office season in the drafting of the maps and in completing the field survey of the five unfinished sheets in the early spring. The rate of field survey as indicated by the above table varied between 2.6 square miles per day per party and 5.7 square miles per day per party, the maximum speed being attained in the flat country in the extreme western New York where the party was at the same time largest in personnel; the minimum in the dense forests of the Adirondacks. The average cost per square mile for field work varied between five dollars and eighty-two cents (\$5.82) in western New York and twenty-five dollars and eighty cents (\$25.80) per square mile, the latter unusually high rate being reached in an exceedingly rough and inaccessible region in the heart of the Adirondacks.

SPIRIT LEVELING.

Five parties were engaged throughout the season in running primary levels, the determination of elevations and the establishment of benchmarks upon which to base the contour sketching of the area mapped. This leveling was executed with the

same care as heretofore and was run in a manner described in my last annual report and in accordance with the official instructions of the director of the United States Geological Survey.

The elevations determined in the course of this spirit leveling are all reduced to mean sea level at Sandy Hook, as they are based upon connections made with the precise levels of the United States Coast and Geodetic Survey from Sandy Hook to Albany and upon the precise levels of the United States Engineers and of the State canals between Albany and Buffalo and finally, upon the precise levels of the United States Geological Survey through southern and central New York.

In the prosecution of this work exclusive of the precise levels already described there were run 1,214 linear miles of levels in the course of which there were established 119 permanent benchmarks of bronze or aluminum and about 1,200 other benchmarks of comparative permanence. There were also determined 8,655 other elevations for the control of contour sketching and of the aneroids barometer used in the sketching.

As it is not proposed to publish herewith lists of benchmarks established in the course of the above work and in order that those desiring to obtain these lists may know of their general locality and thus how to address the director of the United States Geological Survey in obtaining copies of them, I submit the following table showing the localities in which this leveling has been done, the lengths of the closed circuits with the closure error of each from which the quality can be readily ascertained, and the name of the levelman. In addition a large amount of leveling has been done in the same localities but which has not been checked in closed circuits.

LOCALITY.	Length of Circuit.		Levelman.
	Miles.	Feet.	
Newark	30	0.119	Semper, C. H.
Newark	20	0.002	Semper, C. H.
Oswego	71	0.369	Semper and Baxter.
Oswego	30	0.088	Semper, C. H.
Oswego	36	0.004	Semper, C. H.
Oswego	38	0.169	Baxter, D. E.
Palmyra.....	8	0.210	Baxter, D. E.
Palmyra.....	13	0.030	Baxter, D. E.
Newark	45	0.146	Baxter, D. E.
Watkins.....	28	0.050	Gilbert, W. W.
Watkins.....	31	0.011	Gilbert, W. W.
Watkins.....	15	0.126	Gilbert, W. W.
Dryden	33	0.084	Gilbert, W. W.
Dryden	33	0.101	Gilbert, W. W.
Dryden	14	0.003	Gilbert, W. W.
Chemung.....	24	0.087	Gilbert, W. W.
Chemung.....	54	0.140	Gilbert, W. W.
Dunkirk	48	0.168	Faison, E. L.
Dunkirk	45	0.029	Faison, E. L.
Schuylerville	33	0.054	Brown, C.
Schuylerville	47	0.226	Brown, C.
Morrisville	36	0.068	Brown, C.
Morrisville	33	0.019	Brown, C.
Schoharie	25	0.032	Brown, C.
Schoharie	11	0.051	Brown, C.
Canajoharie	36	0.083	Brown, C.
Little Falls.....	33	0.029	Brown, C.

TRAVERSE AND TRIANGULATION LOCATIONS.

For the horizontal control of the topographic maps there were established by plane table triangulation 3,380 positions, the elevations of which were also determined by trigonometric methods. There were run 12,230 linear miles of road traverses and from these there were located by intersection about two thousand additional positions. Accordingly the horizontal control of the maps consists of nearly one trigonometric location per square inch of map, of about three linear inches of plated traverse per square inch of map and of about one location obtained from traverse intersection per square inch of map.

WOODLAND MAPS.

As heretofore the outlines of all wooded areas were obtained in the course of the topographic survey and these are indicated on the manuscript map, copies of which are kept in the office of the United States Geological Survey. For the first time it has been necessary for the State Forest Preserve Board to make use of these woodland maps and copies of them were made in the office of the United States Geological Survey at the request of the secretary of the Forest Preserve Board. These copies show in a faint tint of green all areas which are covered with hard wood or second growth, and as distinguished from this in a darker green, those areas which are covered with virgin forest, such being found only in the Adirondacks. These woodland maps have been of great assistance to the State Forest Preserve Board and Commission in their purchase and study of forest lands and of forest resources of the State.

PUBLISHED ATLAS SHEETS.

In my last annual I enumerated in tabular form all of the atlas sheets which had been published and issued to date. This table gave not only the names of the atlas sheets but the names of the counties indicated upon them and the area of each atlas sheet. From this it appeared that there had been published to that time 72 separate atlas sheets covering a total of 11,755.2 square miles.

Since the publication of my last annual there have been issued from the office of the United States Geological Survey as shown by the following table, six additional atlas sheets, making the total to date of published topography 12,905 square miles.

SHEET NAME.	Counties.	Area, square miles.
Newcomb	Essex, Warren	215.5
Thirteenth Lake.....	Warren, Hamilton, Essex.....	216.4
Olean	Cattaraugus.....	221.6
Utica	Oneida, Herkimer	218.2
Hempstead	Queens.....	145
Oyster Bay.....	Queens, Westchester	134

In addition to the above list which includes the published atlas sheets there yet remain in the hands of the engravers the following, issuance of which from the publication department may be expected:

SHEET NAME.	Counties.	Area, square miles.
Skaneateles	Cayuga, Cortland, Onondaga.....	219
Old Forge	Herkimer, Hamilton.....	217
Indian Lake.....	Hamilton	217
Brockport	Monroe, Genesee	218
Hamlin	Genesee	87
Salamanca	Cattaraugus.....	222
Greater New York	Westchester, Queens, New York, Kings.	425
Cazenovia	Madison, Cortland, Onondaga.....	219
Tully.....	Cortland, Onondaga.....	219
Remsen	Oneida, Herkimer	217

In addition to the above are the sheets listed in table A, opposite page 58, as having been surveyed during the field season of 1898. There have, therefore, been surveyed and mapped to date, 106 separate atlas sheets, representing the topography of 18,515 square miles or nearly 39 per cent. of the area of the State.

SALE OF TOPOGRAPHIC MAPS.

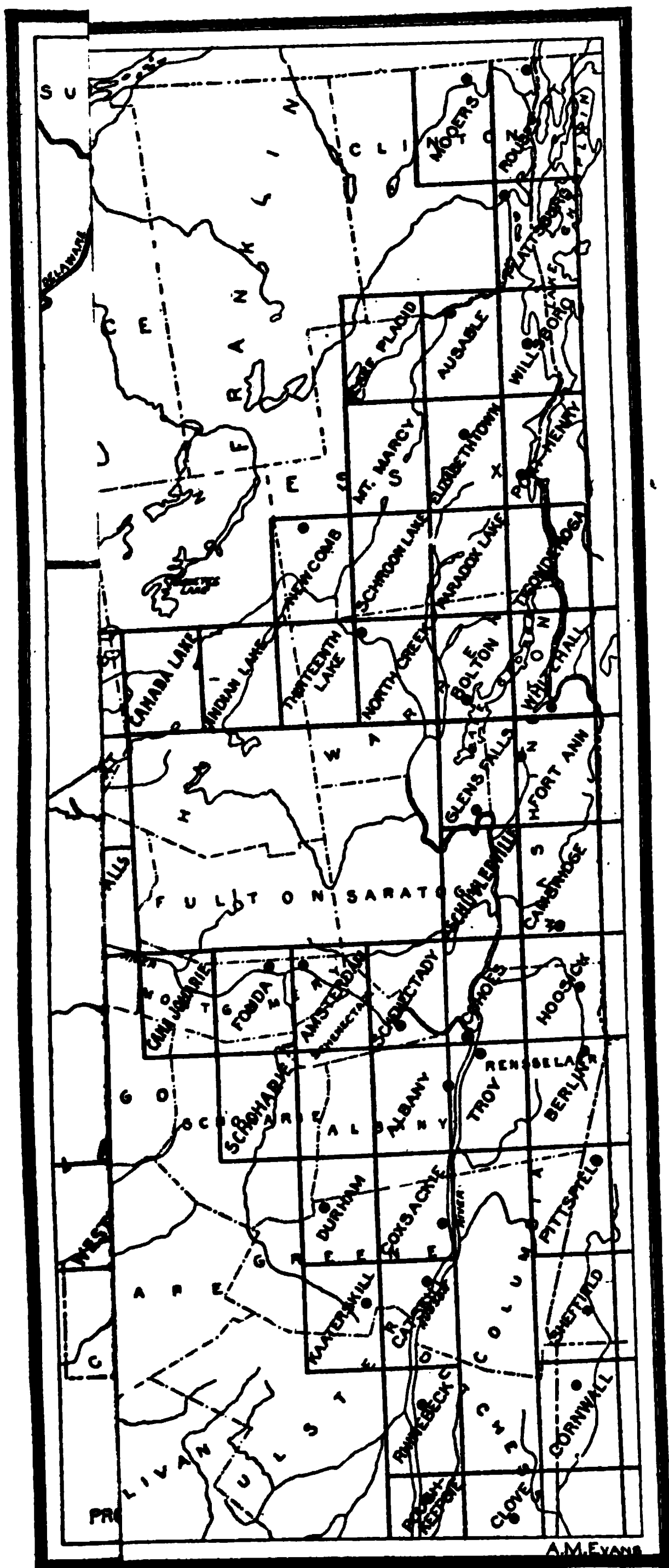
The engraving, printing and issuance of these maps is done entirely by and at the expense of the United States Geological Survey. A certain limited number of proof copies of each is given to the office of the State Engineer for official use. Anyone

else desiring these maps can obtain them at the nominal price of five cents each or at the rate of two dollars per hundred by addressing the Director of the United States Geological Survey, Washington, D. C. It seems unnecessary for me to encumber this report with a list of these sheets or their locations, as catalogues of them can be obtained free of charge on application to the Director, which show not only the price but the position by counties of the various sheets on sale. The accompanying progress map shows the location of all surveyed sheets, including those not yet engraved and published.

CONCLUSIONS AND RECOMMENDATIONS.

I shall not enlarge on the inestimable value of these maps to the State government, railroad and other public corporations and to private individuals resident in the State. These facts have been fully set forth in my previous annual reports as well as in those of my predecessors. I desire to call your attention, however, to the fact that the average cost of making these surveys is about \$12 per square mile, of which the State pays one-half. With this expenditure of \$6 per square mile the outlay to the State ends. That of the Federal Bureau has, however, but commenced, as, in addition to making the topographic maps, the latter engraves and prints them, takes up the study of mineral statistics and of the economic geology of the territory mapped, makes a study of the water and other resources of the State, and the results of these and other allied investigations made at large expense by the general Government, all accrue to the State without further expenditure on its part. In no other way than by this co-operation could the State receive so great benefit for so relatively small an outlay for surveys.

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There remains about 29,140 square miles of the area of the State yet to be mapped. That this work may be pushed to speedy completion, I again urge upon you the appropriation by special act similar to chapter 219 of the general laws of 1898 of the sum of twenty-five thousand dollars (\$25,000) for the continuation of this work during the ensuing fiscal year.

South East.....	Putnam.....	36.39	Carmel.....	Including part of city of Elmira. Including Chittenango village.
Southport.....	Chemung.....	48.80	Elmira.....	
Sullivan.....	Madison.....	74.16	Chittenango.....	
Tuscarora Indian Reservation.	Niagara.....	10.27	Tonawanda.....	
Unionvale.....	Dutchess.....	38.47	Clove.....	
Verona.....	Oneida.....	69.5	Oneida.....	Including Durbanville village.
Wappinger.....	Dutchess.....	28.50	Poughkeepsie.....	Including part of Wappingers Falls village.
Watertown.....	Jefferson.....	45.15	Watertown.....	Including Watertown city.
Watertown (City).....	Jefferson.....	8.11	Watertown.....	
Waterford.....	Saratoga.....	7.8	Cohoes.....	Including Waterford village.
Westchester.....	Westchester.....	16.0	Harlem.....	Including Williamsbridge village.
Westmoreland.....	Oneida.....	47.78	Oriskany, Oneida.....	
Westport.....	Essex.....	69.4	Elizabethtown, Port Henry, Wills- boro.....	
Whitehall.....	Washington.....	62.56	Whitehall.....	Including Westport village.
White Plains.....	Westchester.....	6.41	Harlem, Tarrytown, Stamford...	Including Whitehall village.
Willsboro.....	Essex.....	65.5	Willsboro.....	Including part of White Plains village.
Yorktown.....	Westchester.....	39.65	Tarrytown, West Point.....	

I desire to direct the attention of the Legislature to the reports hereto appended.

The report of Assistant Engineer C. H. Flanigan upon the examination of the boundary lines of the State and the monumenting thereof.

The report upon the Massachusetts boundary line has been given with considerable detail.

The annual reports of the several division engineers are also appended, and reference may be had to them for a detail of the greater portion of work accomplished during the year.

You will also find a special report upon the subject of the Adirondack storage reservoirs, which has been prepared by D. E. Whitford, of the Middle Division Engineer's office. Mr. Whitford has been in the State Engineer's Department for many years—probably longer than any other man now connected with it, and all of his time has been on the Middle Division.

My purpose was to secure a record of the official action in connection with these reservoirs, whether taken by the Legislature, the State Engineer, Superintendent of Public Works, Canal Commissioners or Canal Board. The document is interesting and shows the undoubted ownership of the several reservoirs supplying the Black River canal by the State, even if the question had not been taken up, acted upon and probably settled by the Forest Preserve Board during the past year in the consideration made by it to the Adirondack Lake Club in the purchase of certain lands sold to the State by the club.

Respectfully submitted,

C. W. ADAMS,

State Engineer and Surveyor.

REPORT
OF THE
DIVISION ENGINEER
OF THE
EASTERN DIVISION

For the Year Ending September 30, 1898.

Eastern Division.

OFFICE OF THE DIVISION ENGINEER,

EASTERN DIVISION,

ALBANY, N. Y., *October 1, 1898.*

HON. CAMPBELL W. ADAMS, *State Engineer and Surveyor:*

Sir.—I herewith submit my annual report as division engineer for the Eastern Division of the New York State canals for the fiscal year ending September 30, 1898.

The organization of this Department is the same as last year, excepting that Mr. John G. Tait was appointed resident engineer October 10, 1897, in place of Mr. Albert J. Himes, resigned. Mr. Tait resigned his position as resident engineer August 31st last, since which time the position has been vacant.

The engineering forces have been engaged principally on the work of deepening the canals, as authorized by chapter 79 of the Laws of 1895. The work was prosecuted with vigor until the 1st day of May, when it was practically stopped on account of the funds being exhausted.

The several contracts or sections into which this division was divided, was referred to in detail in my last annual report. At the close of the fiscal year 1897, as stated in said report, twenty contracts for deepening the canals had been awarded, namely: Nos. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 23, 24 and 27, five of which were completed, namely: Nos. 7, 8, 9, 11 and 13. During the past year six additional contracts were awarded, as follows:

Contract No. 28, Champlain canal, extending from lock 20 to

lock 21, a distance of 5.44 miles, which was awarded to Messrs. Pulford & Compton, November 8, 1897.

Contract No. 29, Champlain canal, extending from lock 17 to lock 20, a distance of 6.8 miles, which was awarded to Messrs. Baker, Banker, Hingston & Company, November 11, 1897.

Contract No. 30, Champlain canal, comprising the levels between locks 5 and 6 and locks 7 and 8, a distance of 1.58 miles, which was awarded to John W. Flynn, November 11, 1897.

Contract No. 31, Champlain canal, included the rebuilding of the Moses Kill aqueduct and arch culvert No. 12, which was awarded to Messrs. C. J. Reardon & Company, November 8, 1897.

Contract No. 52, Erie canal, consisted in rebuilding the berme abutment of bridge No. 156, which was awarded to John Twomey, March 11, 1898.

Contract No. 53, Champlain canal, comprises the rebuilding of bridge No. 7 and the berme approach thereto, the same being awarded to Messrs. Monty & Higley, March 28, 1898.

A statement showing the status of each contract has already been furnished to you, which I understand is to be embodied in your annual report; therefore, it need not be repeated here.

The total number of contracts awarded on this division was twenty-six, covering 84.46 miles; eighteen on the Erie canal, covering 54.59 miles, and eight on the Champlain canal, covering 29.87 miles.

Of the above number sixteen are completed and final accounts rendered, namely: Nos. 2, 3, 4, 5, 7, 11, 12, 13, 15, 17 and 52, on the Erie canal, covering 26.6 miles, and Nos. 8, 9, 30, 31 and 53, on the Champlain canal, covering 5.88 miles. On the unfinished contracts there are 18.26 miles completed, making a total of completed canal on this division 50.74 miles. The work on the ten unfinished contracts is about two-thirds completed.

Cost of work on completed contracts.....	\$1,157,261 82
Cost of work done on unfinished contracts.....	808,634 11
	<hr/>
Total cost of work done.....	\$1,965,895 93
Estimated cost to complete all unfinished con-	
tracts at present contract prices.....	418,130 00
	<hr/>
Total.....	\$2,384,025 93
	<hr/> <hr/>
Engineers' preliminary estimates.....	\$2,066,754 51
Excess over preliminary estimates.....	317,271 42
Percentage of cost over preliminary estimates....	15.35
	<hr/> <hr/>

Table No. 34 accompanying this report shows contracts completed and final accounts rendered during the year.

Table No. 35 shows contracts pending September 30, 1898.

Note.—Contracts 3 and 5 (Table No. 35), were completed before September 30th, but the final accounts were not prepared until a few days later.

Some work was done after the funds under chapter 79 were exhausted to put the canal in proper shape for navigation, which was paid from chapter 506 of the Laws of 1898. The sum given above as the total cost of all work done includes estimates paid from chapter 506. This covers the cost of all work under the contracts up to the close of the fiscal year 1898. The estimates are all completed, except contract 10, which is approximate.

The canals are now in very good condition so far as the work has progressed. There is nothing resulting from said work that will interfere with navigation. A few old culverts should be rebuilt, as they are in an unsafe condition. The floors are badly decayed and since the old impervious canal bottom has been disturbed, water percolates down through porous soil and works

under the foundations of these structures, and as it is acting under a considerable head, soon forms dangerous leaks.

Arch culvert 39 should be rebuilt and culverts 40, 45 and 75 should be replaced with iron pipe.

Several bad breaks occurred on this division during the past season. On May 3, 1898, culvert 45, between locks 28 and 29, failed, the portion extending underneath the towing path being carried away with about fifty lineal feet of the towing embankment, caused by the water working up under the foundation and undermining the structure. The portion of the culvert extending through the prism was covered with a jacket of concrete the previous winter and remained intact. Repairs were made by building a wooden trunk in place of the portion carried away. The work was hindered considerably by rainy weather and the high water in the river which backed up into the culvert. The water was again let into the canal May 10th. On August 20th a leak occurred at this culvert beyond the portion which had previously been repaired. The masonry was not damaged this time, but the water had to be drawn down for repairs. This structure should be replaced with 48-inch cast iron pipe.

On May 12th the most disastrous break of the season occurred along the high embankment about 700 feet west of lock 24. The break was about 250 feet long and extended down 22 feet below canal bottom. The canal at this place runs along a steep side hill, the outer portion being built up from the bed of the river. The filling was composed largely of sand which extended up to within two feet of canal bottom and covered with puddle. The sand had become saturated and the whole embankment moved out bodily into the river. In improving the canal at this point no excavation had been done in the bottom of the prism, as the old canal bottom was below new grade; but in consequence of

the work being done, the level had been thoroughly drained, leaving the puddle exposed to the frost. This undoubtedly produced cracks which permitted the water to seep through into the sand. The break was repaired in nine days.

On August 20th a leak occurred in culvert 38 of the Erie canal caused by the water forcing up the bottom of the culvert. The masonry was not damaged, repairs were made by filling up the hole with concrete and puddle. Navigation was delayed four and a half days.

October 5th a heavy rain caused the 16-mile level of the Champlain canal to overflow the banks, and carried away a portion of the Wilbur's basin waste wier. Repairs were made by building a cofferdam in front of the arch leading to the spillway. This structure should be rebuilt at once and should have gates of much greater capacity than the old one. As the stream leading to it is subject to great fluctuation and in this instance, had the structure remained in tact much greater damage might have been done elsewhere.

In addition to the above mentioned structures, I would also recommend that locks 6, 7 and 14 of the Champlain canal be rebuilt. The masonry in these structures is badly bulged and it has been necessary to cut back the wall from two to five inches in order to admit boats into the chambers. The face stones have apparently separated from the backing and the freezing of the water which accumulates in the crevices during winter forces the face stones in towards the chambers. Plans have already been prepared for rebuilding locks 6 and 7 and the work advertised, but owing to lack of funds the contracts were not let.

Bridge No. 124, Erie canal, located at St. Johnsville should be replaced with an iron structure. This is a whipple wooden bridge with wrought iron lower chords 86 feet clear span, 16 feet

roadway. It was erected in 1884 and the timbers are badly decayed. As the bridge is subject to considerable heavy traffic it is not safe.

EXTRAORDINARY REPAIRS.

German street bridge.—Chapter 680, Laws of 1895, appropriated \$8,000. This act provided for rebuilding the canal bridge and towing path abutment at German street, Little Falls. The contract was awarded to the Rochester Bridge & Iron Works, November 16, 1895. After the contractor had procured the material the work was suspended by orders as it was thought that the improvement to the canals, which had just been approved by the popular vote, might change the alignment at this place. The result of the surveys, however, did not produce the expected change, therefore the work was resumed last winter and finished before the opening of navigation. Chapter 572, Laws of 1897, reappropriated the unexpended balance of the funds.

Ilion lift bridge.—Chapter 105, Laws of 1897, appropriated \$18,000. This act provided for building a lift bridge at Railroad street, Ilion. The contract was awarded to the Hilton Bridge Construction Company June 6, 1897, and was completed the following spring. The bridge works very satisfactorily and is a great improvement to the village.

Rexford Flats dam.—Chapter 947, Laws of 1896, and chapters 566 and 572, Laws of 1897. As mentioned in my last report the contract was awarded to Messrs. Whalen & Higgins for rebuilding apron to the Rexford Flats dam, September 14, 1897. The contractors had the work about two-thirds completed and cofferdams built for the balance. On December 6th a freshet in the river carried away their cofferdams and machinery, and work was then suspended and not resumed until July 1st. The work is now nearly completed. Chapter 566, Laws of 1897, appro-

priated \$350,000 for extraordinary repairs to the canals. The greater portion of the work under this appropriation was done under the direction of the Superintendent of Public Works.

The following work was done by contract on the Eastern Division:

The iron bridge at Railroad street, Ilion, N. Y., which was replaced by a lift bridge, was re-erected at Reese's Road, Frankfort. The contract was awarded to the Hilton Bridge Construction Company.

Chapter 578, Laws of 1897, reappropriated an unexpended balance of \$2,887.93 of a former appropriation for building a vertical wall along the berme bank of the Glens Falls feeder between the guard lock and change bridge. The Canal Board set aside an additional sum of \$10,000 from chapter 566 for this purpose. The contract was awarded to Monty, Higley & Barber, October 8, 1897. This much-needed improvement was completed before the opening of navigation last spring.

Ship street bridge.—Chapter 778, Laws of 1897, appropriated \$6,000 for improving the approaches to a bridge over the Champlain canal at Ship street, Cohoes. The bridge was built several years ago, and the approaches were left in a very dangerous condition. The work consisted in widening and grading the approaches, building sidewalks, retaining-walls and guard rails. The contract was awarded to Henry Hall, October 11, 1897, and was completed January 1, 1898.

Fourth street bridge, Waterford.—Chapter 575, Laws of 1897, appropriated \$4,000 to rebuild the towing-path abutment and erect a plate girder bridge in place of the old cast-iron structure which had been condemned. The contract was awarded to the Havana Bridge Works, September 30, 1897, and completed May 1, 1898.

Lift bridge at River street, Fort Plain.—Chapter 576, Laws of 1897; appropriation, \$14,000. The contract was awarded to the Havana Bridge Works, November 9, 1897. The bridge was completed and ready for operation at the opening of navigation last spring, and works very satisfactorily.

APPROPRIATIONS FOR WORK NOT CONNECTED WITH THE CANALS.

Repairs to Drake's drawbridge.—Chapter 949, Laws of 1897, appropriated \$1,500 for repairing the drawbridge over Wappingers creek, Dutchess county, and improving the approaches thereto. The contract was awarded to O. F. Hilt, April 29, 1897.

Racquette river dam.—Chapter 158, Laws of 1896, appropriated \$2,000 for this work. The contract was awarded to William Coates, August 31, 1897, and completed November 15, 1897. The object of this dam was explained in my last annual report.

Shinnecock and Peconic canal.—Chapter 791, Laws of 1897, appropriated \$5,000 for repairing and maintaining the gates and piling on the Shinnecock and Peconic canal. The work was done under an agreement with P. J. Brummelkamp, who had the contract for constructing the gates.

Shinnecock and Great South bay.—Chapter 207, Laws of 1898, appropriated \$10,000 for completing the canal between the bays above mentioned. The contract was awarded to E. W. Wicks, June 14, 1898, and the work is now under way.

State road, town of Colton.—Chapter 606, Laws of 1898, appropriated \$2,000 for improving a portion of the State road in the town of Colton, St. Lawrence county, under the direction of the State Engineer and Surveyor. The work was done by day's labor. Mr. Hugh Fallon, the commissioner of highways of said town, was appointed foreman and Mr. Seth M. Van Loan repre-

sented this Department. About four miles of road was improved.

IMPROVEMENT OF PUBLIC HIGHWAYS—CHAPTER 115, LAWS OF 1898.

Under this act surveys have been made for the improvement of the following highways:

Troy and Schenectady turnpike, Schenectady county.

New Lebanon-Pittsfield road, Columbia county.

Road from Nyack to West Nyack, Rockland county.

Troy and Greenbush road and old stone road, Rensselaer county.

Northampton road, Montgomery county.

Road from Goshen to Middletown, Orange county.

The contract for improving two miles of the Troy and Schenectady turnpike was awarded to the Callanan Road Improvement Company, September 7, 1898. The work consisted of grading, draining, building culverts and macadamizing. The roadbed, after being properly graded, was covered for a width of 16 feet with broken stone 6 inches in depth, after being thoroughly compacted, the lower course to be South Bethlehem limestone and the surface trap rock. The engineer's estimate is \$14,600 and the contractor's bid was \$14,590. The work is now under way. The plans have been prepared for changing the alignment, grading and graveling.

About one and one-quarter miles of the road leading from New Lebanon to Pittsfield has been surveyed and estimates prepared, but the work has not yet been advertised.

BOARD OF CLAIMS.

Work under chapter 606, Laws of 1898, consists of making surveys and maps, at the request of the Attorney-General, to be used

in defense of actions brought against the State for damages. This work has been in charge of Mr. T. C. Leutze, first assistant engineer.

TOPOGRAPHIC SURVEY.

Chapter 219, Laws of 1898; appropriation, \$25,000. The work under this act is done under the direction of the United States Geological Survey.

Plans have been prepared under the following laws, but the contracts have not yet been awarded:

Chapter 562 of the Laws of 1897, for a lift bridge at Canajoharie.

Chapter 621, Laws of 1898, to improve and change the channels of the streams in the town of Mamakating, Sullivan county, known as the Basha's kill and Pine kill.

Chapter 631, Laws of 1898, for repairs to draw bridge over the Minisceonge creek, Rockland county.

Chapter 606, Laws of 1898, to erect a wall along the northern boundary of the Washington Monument headquarters, at Newburgh, N. Y.

Chapter 627, Laws of 1898, for rebuilding a dam across the Saranac river, Franklin county.

Chapter 623, Laws of 1898, for constructing a steel bridge over the Glens Falls feeder, at Main street, Sandy Hill.

We have also frequently been called upon by the Superintendent of Public Works for plans and estimates in connection with the ordinary and extraordinary repairs to the canals.

Tables Nos. 1 to 33 show the names of persons employed, the time of service and rate of compensation of each.

Respectfully submitted,

DE WITT C. SMITH,

Division Engineer.

STATEMENT showing names, rank, number of days and compensation of Engineers employed on the Eastern Division of the New York State Canals, together with incidental expenses during the fiscal year ending September 30, 1898.

Ordinary Repairs—Erie Canal.
(Chapter 435, Laws of 1897.)

(No. 1.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
De Witt C. Smith.....	Division engineer.....	.....	\$3,000 00 per year.	\$2,000 04	\$405 71	\$2,405 75
John G. Tait.....	Resident engineer.....	.....	2,400 00 per year.	100 00	42 01	142 01
T. C. Leutze.....	First assistant engineer...	7	6 00 per day..	42 00	81 40	123 40
Douglas Cornell	Assistant engineer.....	14	5 00 per day..	70 00	12 24	82 24
F. A. Bagg.....	Assistant engineer.....	13	5 00 per day..	65 00	16 40	81 40
Dorlon Clark.....	Leveler.....	79	4 50 per day..	355 50	1 18	356 68
George L. Schillner	Draftsman	26	4 50 per day..	117 00	.....	117 00
Frank Roberts.....	Rodman.....	166	3 50 per day..	581 00	7 57	588 57
C. M. Pepson.....	Rodman.....	345	3 50 per day..	1,207 50	59 22	1,266 72
Charles G. Douw.....	Rodman.....	18	3 50 per day..	63 00	14 53	77 53
George McDonald.....	Chainman.....	29	2 50 per day..	72 50	.....	72 50
H. J. Richardson	Chainman.....	18	3 50 per day..	63 00	15 97	78 97
Henry F. Smith.....	Chainman.....	53	3 50 per day..	185 50	23 98	209 48
						\$5,602 25
Incidental expenses.						
Labor.....	.....	.....	.....	.....	\$744 00	
Livery.....	.....	.....	.....	.....	5 00	
Stationery .....	.....	.....	.....	.....	113 20	
Postage.....	.....	.....	.....	.....	46 20	
Telegraph and telephone .....	.....	.....	.....	.....	70 02	
Miscellaneous .....	.....	.....	.....	.....	972 95	
						1,951 37
						\$7,553 62

(No. 4.)
Extraordinary Repairs—Champlain Canal.
(Chapter 947, Laws of 1896; Chapter 566, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
John R. Kaley	First assistant engineer.....	47	\$6 00 per day.....	\$282 00	\$31 28	\$313 28
Foster B. Morss	Assistant engineer.....	79	5 00 per day.....	395 00	46 22	441 22
M. P. Quintana	Assistant engineer.....	84	5 00 per day.....	420 00	34 69	454 69
F. J. Lempe	Leveler	161	4 50 per day.....	724 50	140 37	864 87
L. B. Jones	Leveler	26	4 50 per day.....	117 00	12 10	129 10
T. A. Hendrickson	Leveler	21	4 50 per day.....	94 50	9 90	104 40
John A. O'Connor	Draftsman	80	3 50 per day.....	280 00	18 20	298 20
William J. Gilmore	Chainman.....	53	3 50 per day.....	185 50	10 14	195 64
R. M. Booth	Chainman.....	26	3 50 per day.....	91 00	7 33	98 33
George McDonald	Chainman.....	24	2 50 per day.....	60 00	12 98	72 98
Incidental expenses.						
Livery					\$135 75	\$2,972 71
Miscellaneous					104 12	239 87
						\$3,212 58

Extraordinary Repairs—Erie Canal.

(No. 3.)

(Chapter 947, Laws of 1896, and Chapter 566, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze	First assistant engineer....	5	\$6 00 per day.....	\$30 00	\$36 37	\$66 37
A. M. Evans	Assistant engineer.....	53	5 00 per day.....	265 00	20 98	285 98
W. L. Lawton	Assistant engineer.....	12	5 00 per day.....	60 00	3 07	63 07
C. C. Huestis	Assistant engineer.....	56	5 00 per day.....	280 00	48 65	328 65
C. W. Trumbull.....	Assistant engineer.....	41	5 00 per day.....	205 00	7 73	212 73
H. P. Willis	Leveler	53	4 50 per day.....	238 50	4 00	242 50
F. S. Strong	Leveler	20	4 50 per day.....	90 00	11 54	101 54
George L. Schillner	Draughtsman	27	4 50 per day.....	121 50	2 90	124 40
James K. Browne	Rodman	48	3 50 per day.....	168 00	57 99	225 99
R. S. Greenman	Rodman	53	3 50 per day.....	185 50	.....	185 50
H. W. DeGraff	Rodman	53	3 50 per day.....	185 50	2 41	187 91
O. J. Dempster	Rodman	26	3 50 per day.....	91 00	3 84	94 84
William Van Epps	Chainman	18	3 00 per day.....	54 00	18 10	72 10
Frank Lutz.....	Chainman	58	3 00 per day.....	159 00	.....	159 00
Parkes D. Wendell	Chainman	13	3 50 per day.....	45 50	.....	45 50
Ralph Russell.....	Chainman	53	4 50 per day.....	238 50	83 76	322 26
James T. Brady.....	Chainman	57	2 50 per day.....	142 50	16 36	158 86
						\$2,877 20
<i>Incidental expenses.</i>						
Labor					\$100 95	
Livery					208 00	
Office rent.....					36 00	
Telegraph and telephone.....					6 01	
Stowell & Cunningham					116 50	
Miscellaneous.....					5 70	
						473 16
						\$3,350 36

Improvement Erie Canal—Continued.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
R. S. Greenman	Rodman.....	247	\$3 50 per day..	\$864 50	\$5 22	\$869 72
E. G. Blessing.....	Rodman.....	159	3 50 per day..	556 50	58 38	614 88
John C. Ranney.....	Rodman.....	121	3 50 per day..	423 50	4 19	427 69
Frank Roberts.....	Rodman.....	73	3 50 per day..	255 50	18 31	273 81
James K. Browne	Rodman.....	121	3 50 per day..	423 50	7 40	430 90
Geo. E. Cook.....	Rodman.....	197	3 50 per day..	689 50	94	690 44
John G. Stewart.....	Chainman.....	193	2 50 per day..	482 50	25 94	508 44
J. B. Tiffney.....	Chainman.....	193	2 50 per day..	482 50	25 23	507 73
Frank Bartlett.....	Chainman.....	193	2 50 per day..	482 50	.....	482 50
H. C. Titus	Chainman.....	184	2 50 per day..	460 00	.....	460 00
C. J. Reardon.....	Chainman.....	186	2 50 per day..	465 00	.....	465 00
Frank Kromer	Chainman.....	183	2 50 per day..	457 50	23 66	481 16
I. I. Yates.....	Chainman.....	95	2 50 per day..	237 50	7 34	244 84
L. Potter	Chainman.....	182	2 50 per day..	455 00	19 42	474 42
John Weeks	Chainman.....	261	2 50 per day..	652 50	7 51	660 01
A. F. Pfan.....	Chainman.....	183	2 50 per day..	457 50	21 81	479 31
Parks D. Wendell.....	Chainman.....	241	3 50 per day..	843 50	21 05	864 55
H. M. Booth	Chainman.....	125	3 50 per day..	437 50	4 59	442 09
William Van Epps	Chainman.....	50	3 00 per day..	150 00	6 16	156 16
Frank Lutz.....	Chainman.....	261	3 00 per day..	783 00	1 14	784 14
George Kirk, Jr.....	Chainman.....	122	2 50 per day..	295 00	1 67	296 67
Henry F. Smith	Chainman.....	203	3 50 per day..	710 50	15 80	726 30
Ralph Russell.....	Chainman.....	248	4 50 per day..	1,116 00	386 51	1,502 51
L. L. Melins	Chainman.....	156	3 00 per day..	468 00	6 45	474 45
James T. Brady.....	Chainman.....	242	2 50 per day..	605 00	30 16	635 16
F. B. Stoddard.....	Chainman.....	149	2 50 per day..	372 50	2 77	375 27
Frank L. Fonda.....	Chainman.....	152	2 50 per day..	377 50	5 43	382 93
William Powers.....	Chainman.....	149	2 50 per day..	372 50	.....	372 50
Orra Westover.....	Chainman.....	147	2 50 per day..	367 50	.....	367 50
George McDonald	Chainman.....	229	2 50 per day..	572 50	1 10	573 60

L. Dedrick.....	Chainman.....	67	2 50 per day..	167 50	12 68	180 18
W. E. Petty	Chainman.....	231	2 50 per day..	547 50	20 98	568 48
H. J. Richardson.....	Chainman.....	179	3 50 per day..	626 50	41 45	667 95
Incidental expenses.						
George P. Hilton.....					\$30 75	
Dutton Pneumatic Lock and Engineering Co.....					4,500 00	
Fuel and light					39 38	
Telegraph and telephone.....					422 06	
Office rent					833 00	
Stationery					1,321 26	
Labor					5,728 30	
Livery.....					7,708 30	
Miscellaneous.....					1,467 77	
					22,050 82	
						\$65,483 95

Improvement Champlain Canal.

(Chapter 73, Laws of 1895; Chapter 784, Laws of 1896, and Chapters 43 and 509, Laws of 1897.)

(No. 6.)

NAME.	Rank.	Number of days.	Salary.	Travel.	Total.
John G. Tait.....	Resident engineer.....	\$2,400 00 per year..	\$973 73	\$263 18	\$1,241 90
John R. Knley	First assistant engineer.....	6 00 per day..	1,452 00	250 00	1,702 00
Monroe Warner.....	Assistant engineer.....	5 00 per day..	1,340 00	184 37	1,524 37
Foster B. Moras.....	Assistant engineer.....	5 00 per day..	1,180 00	113 75	1,293 75
M. P. Quintana.....	Assistant engineer.....	5 00 per day..	890 00	6 78	896 78
Frank S. Sanders	Leveler.....	4 50 per day..	1,066 50	104 14	1,170 64
C. H. Nichols	Leveler.....	4 50 per day..	837 00	7 86	844 86
T. A. Hendrickson	Leveler.....	4 50 per day..	1,075 50	225 28	1,300 78
L. B. Jones.....	Leveler.....	4 50 per day..	1,093 50	78 39	1,171 89
F. J. Lempe	Leveler.....	4 50 per day..	472 50	23 51	496 01
Edward P. Folger.....	Leveler.....	4 50 per day..	522 00	7 00	529 00
Foster B. Moras.....	Draftsman	4 50 per day..	45 00	.....	45 00
John A. O'Connor.....	Draftsman	3 50 per day..	840 00	52 88	892 88
O. C. Richards	Rodman	3 50 per day..	406 00	8 47	414 47
Edward P. Folger.....	Rodman.....	3 50 per day..	49 00	.....	49 00
W. S. Jones.....	Rodman.....	3 50 per day..	927 50	39 80	967 30
H. S. Miller.....	Chainman.....	3 00 per day..	529 00	82 70	611 70
R. M. Booth	Chainman.....	3 50 per day..	863 00	32 06	895 06
George H. Moulthrop	Chainman.....	2 50 per day..	395 00	3 25	398 25
W. B. Strong.....	Chainman.....	2 50 per day..	457 50	8 40	465 90
W. J. Gilmore.....	Chainman.....	3 50 per day..	962 50	64 42	1,026 92
F. H. Owens	Chainman.....	2 50 per day..	455 00	.....	455 00
W. B. Ingallsbe.....	Chainman.....	2 50 per day..	480 00	4 62	484 62
A. S. McMurray.....	Chainman.....	2 50 per day..	460 00	.....	460 00
F. G. Tilton	Chainman.....	2 50 per day..	655 00	3 74	658 74
Charles R. Conklin.....	Chainman.....	2 50 per day..	7 50	.....	7 50
Jesse Patrick	Chainman.....	2 50 per day..	455 00	4 74	459 74
A. R. Newton	Chainman.....	2 50 per day..	372 50	19 70	392 20
Luke F. Kelley	Chainman.....	2 50 per day..	280 00	28 40	308 40
William Van Epps	Chainman.....	3 00 per day..	552 00	46 47	598 47

John W. Inman.....	Chainman.....	147	2 50 per day..	367 50	18 06	385 56
Lawrence O'Keefe.....	Chainman.....	134	2 50 per day..	335 00	7 39	342 39
H. J. Richardson.....	Chainman.....	15	3 50 per day..	52 50	14 13	66 63
George McDonald.....	Chainman.....	28	2 50 per day..	70 00	5 73	75 73
						\$22,232 44
<i>Incidental expenses.</i>						
George P. Hilton					\$59 00	
Fuel and light					129 65	
Telegraph and telephone.....					163 09	
Stationery					629 20	
Postage					1 35	
Office rent					471 43	
Labor.....					2,197 00	
Livery					3,984 25	
Miscellaneous					1,025 28	
						8,640 25
						\$30,872 69

Rebuilding Rexford Flats Dam.

(Chapter 560, Laws of 1895; Chapter 947, Laws of 1896; Chapter 566, Laws of 1897.)

(No. 7.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
C. C. Huestis	Assistant engineer	57	\$5 00 per day	\$285 00	\$47 44	\$332 44
F. J. Lempe	Leveler	58	4 50 per day	261 00	5 77	266 77
W. E. Petty	Chainman	60	2 50 per day	150 00	.....	150 00
L. Dedrick	Chainman	55	2 50 per day	137 50	13 38	150 88
Incidental expenses.						
Office rent .....	.....				\$7 00	
Fuel and light .....	.....				2 00	
Telegraph and telephone .....	.....				1 04	
Miscellaneous .....	.....				.7 59	17 63
						\$917 72

Fourth Street Bridge, Waterford.

(Chapter 575, Laws of 1897.)

(No. 2.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
M. P. Quintana.....	Assistant Engineer	27	\$5 00 per day.....	\$135 00	\$22 44	\$157 44
T. A. Hendrickson.....	Leveler	7	4 50 per day.....	31 50	7 15	38 65
George H. Moulthrop.....	Chainman.	26	2 50 per day.....	65 00	.....	65 00
Lawrence P. O'Keefe.....	Chainman.	12	2 50 per day.....	30 00	.....	30 00
						\$291 09

Ship Street Bridge, Cohoes.

(Chapter 778, Laws of 1897.)

(No. 2.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
M. P. Quintana	Assistant engineer.....	26	\$5 00 per day.....	\$130 00	\$9 25	\$139 25
T. A. Hendrickson.....	Leveler	26	4 50 per day.....	117 00	13 95	130 95
L. B. Jones	Leveler	28	4 50 per day.....	126 00	9 80	135 80
Lawrence P. O'Keefe.....	Chainman.....	5	2 50 per day.....	12 50	1 10	13 60
						\$419 60

(No. 10.)
Railroad Street Lift Bridge, Union, N. Y.
(Chapter 105, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Perry Filkins	Rodman.....	26	\$3 50 per day.....	\$91 00	\$7 93	\$98 93
Ralph Russell.....	Chainman.....	27	4 50 per day.....	121 50	22 12	143 62
L. L. Melius	Chainman.....	27	3 00 per day.....	81 00	1 25	82 25
<i>Incidental expenses.</i>						
Labor					\$60 75	
Office rent.....					12 00	
						\$324 80
						72 75
						\$397 55

German Street Bridge, Little Falls.

(No. 11.)

(Chapter 630, Laws of 1895.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Stowell & Cunningham	\$27 98

River Street Lift Bridge, Fort Plain.

(No. 12.)

(Chapter 576, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Stowell & Cunningham	\$141 45

Glen Street Bridge, Glens Falls.

(No. 13.)

(Chapter 798, Laws of 1896.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
E. J. Dempster.....	Rodman.....	3	\$3 50 per day.....	\$10 50	\$2 12	\$12 62
Incidental expenses.						
Labor					\$67 50	\$12 62
Miscellaneous.....					1 80	69 30
						\$81 92

(No. 14.) *Maple Street Bridge, Sandy Hill.*
(Chapters 286, Laws of 1895, and Chapter 795, Laws of 1896.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. A. Hendrickson	Leveler	27	\$4 50 per day.....	\$121 50	.....	\$121 50
<i>Incidental expenses.</i>						
Livery					\$20 00	
Office rent					15 00	
						35 00
						\$156 50

Canajoharie Lift Bridge.

(Chapter 592, Laws of 1894, and Chapter 562, Laws of 1897.)

(No. 15.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
George P. Hilton	\$332 55
Brandow Printing Co.	16 81
						\$349 36

Cemetery Culvert, Waterford.

(Chapter 215, Laws of 1896.)

(No. 16.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Labor	\$67 50
Miscellaneous	7 39
						\$74 89

Culvert over Weigh Lock Outlet, Waterford.

(No. 17.)

(Chapter 364, Laws of 1896.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
George McDonald	Chainman.....	27	\$2 50 per day.....	\$67 50	\$10 15	\$77 65

Basha's Kill Stream.

(No. 18.)

(Chapter 621, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Lentze.....	First assistant engineer....	7	\$6 00 per day.....	\$42 00	\$30 06	\$72 06
Dorlon Clark.....	Leveler	4	4 50 per day.....	18 00	26 71	44 71
F. S. Strong.....	Leveler	1	4 50 per day.....	4 50	8 06	12 56
Frank Roberts.....	Rodman.....	2	3 50 per day.....	7 00	10 51	17 51
William Van Epps	Chainman.....	3	3 00 per day.....	9 00	10 76	19 76
						\$166 60

Drawbridge Over Miniscedago Creek.
(Chapter 631, Laws of 1898.)

(No. 19.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze.....	First assistant engineer....	5	\$6 00 per day.....	\$30 00	\$16 15	\$46 15
F. S. Strong.....	Leveler	3	4 50 per day.....	13 50	20 54	34 04
Frank Roberts.....	Rodman.....	3	3 50 per day.....	10 50	12 70	23 20
William Van Epps.....	Chainman.....	4	3 00 per day.....	12 00	14 90	26 90
						\$130 29

Washington Monument Headquarters at Newburgh.
(Chapter 790, Laws of 1897, and Chapter 606, Laws of 1898.)

(No 20.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze.....	First assistant engineer....	1	\$6 00 per day.....	\$6 00	\$4 74	\$10 74

State Road, Town of Colton, St. Lawrence County.

(No. 21.)

(Chapter 606, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Seth M. Van Loan.....	Leveler	61	\$4 50 per day.....	\$274 50	\$54 90	\$329 40
Incidental expenses.						
Labor					\$1,212 95	
Miscellaneous					456 75	
						1,669 70
						\$1,999 10

State Road, St. Regis Reservation.

(No. 22.)

(Chapter 932, Laws of 1895.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze	First assistant engineer....	8	\$8 00 per day.....	\$48 00	\$82 62	\$130 62

Shinnecock and Peconic Canal (Piling and Protecting).

(No 23.)

(Chapter 950, Laws of 1896, and Chapter 791, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze	First assistant engineer.....	6	\$6 00 per day.....	\$36 00	\$58 79	\$94 79
A. M. Evans	Assistant engineer.....	6	5 00 per day.....	30 00	20 88	50 88
Guy H. Miller.....	Leveler.....	13	4 50 per day.....	58 50	7 49	65 99
Henry F. Smith.....	Chainman.....	27	3 50 per day.....	94 50	20 01	114 51
John J. Allen .....	.....	3	5 00 per day.....	15 00	21 78	36 78
.						
Incidental expenses.						
Labor .....	.....				\$64 00	
Livery.....	.....				15 00	
Miscellaneous.....	.....				84 36	
						\$163 36
						\$526 31
					\$362 95	

Shinnecock and Great South Bay (Dredging).

(No. 24.)

(Chapter 207, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze.	First assistant engineer.	9	\$6 00 per day.	\$54 00	\$80 08	\$134 08
Douglas Cornell.	Assistant engineer.	44	5 00 per day.	220 00	68 96	288 96
Dorlon Clark.	Leveler.	5	4 50 per day.	22 50	26 51	49 01
F. S. Strong.	Leveler.	7	4 50 per day.	31 50	31 58	63 08
Frank Roberts.	Rodman.	5	3 50 per day.	17 50	22 41	39 91
Henry F. Smith.	Chainman.	26	3 50 per day.	91 00	22 13	113 13
H. J. Richardson.	Chainman.	5	3 50 per day.	17 50	25 02	42 52
William Van Epps.	Chainman.	5	3 00 per day.	15 00	24 01	39 01
<i>Incidental expenses.</i>						
Labor.					\$28 00	
Telegraph and telephone.					6 00	
Miscellaneous.					37 14	
						71 14
						\$840 84

Sea Wall at Orient.

(Chapter 828, Laws of 1895.)

(No. 25.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
John G. Tait.....	Resident engineer.....	4	\$2,400 00 per year.	.....	.....	\$23 80

Building Dyke Neversink River, Town of Deerpark.

(Chapter 291, Laws of 1897.)

(No. 26.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze.....	First assistant engineer....	4	\$6 00 per day..	\$24 00	\$49 55	\$73 55
F. S. Strong.....	Leveler	2	4 50 per day..	9 00	20 61	29 61
Guy H. Miller.....	Leveler	40	4 50 per day..	180 00	7 11	187 11

Incidental expenses.

Telegraph and telephone expenses		\$290 27
		6 32
		\$296 59

Rebuilding Saranac Dam.

(Chapter 627, Laws of 1898.)

(No. 27.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
De Witt C. Smith.....	Division engineer.....	.....	\$3,000 00 per year.	.....	\$37 16	\$37 16
T. C. Leutze.....	First assistant engineer....	17	6 00 per day..	\$102 00	186 58	288 58
F. S. Strong.....	Leveler.....	12	4 50 per day..	54 00	58 93	112 93
Frank Roberts.....	Rodman.....	12	3 50 per day..	42 00	47 95	89 95
William Van Epps.....	Chainman.....	4	3 00 per day..	12 00	18 96	30 96
H. J. Richardson.....	Chainman.....	8	3 50 per day..	28 00	33 33	61 33
John J. Allen.....	.....	5	5 00 per day..	25 00	28 33	53 33
Incidental expenses.						
Labor.....					\$14 00	
Miscellaneous.....					14 91	
						28 91
						\$674 24
						\$703 15

Improvement Public Highways—Troy and Schenectady Turnpike.

(No. 28.)

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze.....	First assistant engineer.....	10	\$6 00 per day.....	\$60 00	\$12 69	\$72 69
W. L. Lawton	Assistant engineer.....	31	5 00 per day.....	155 00	7 26	162 26
Dorlon Clark.....	Leveler	6	4 50 per day.....	27 00	8 40	35 40
George L. Schillner	Draughtsman	2	4 50 per day.....	9 00	.....	9 00
Frank Roberts	Rodman.....	14	3 50 per day.....	49 00	17 26	66 26
H. J. Richardson.....	Chainman	6	3 50 per day.....	21 00	8 50	29 50
William Van Epps	Chainman	25	3 00 per day.....	75 00	15 74	90 74
Parkes D. Wendell.....	Chainman	19	3 50 per day.....	66 50	6 57	73 07
Incidental expenses.						
Livery						\$538 92
						38 00
						\$576 92

Improvement Public Highways — Lebanon and Pittsfield Road.
(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze	First assistant engineer.....	15	\$6 00 per day.....	\$90 00	\$102 01	\$192 01
Douglas Cornell.....	Assistant engineer.....	10	5 00 per day.....	50 00	21 46	71 46
Dorlon Clark.....	Leveler	6	4 50 per day.....	27 00	15 12	42 12
F. S. Strong	Leveler	10	4 50 per day.....	45 00	22 72	67 72
Frank Roberts	Rodman.....	18	3 50 per day.....	62 50	33 97	96 47
William Van Epps	Chainman	11	3 00 per day.....	33 00	25 40	58 40
Henry F. Smith.....	Chainman	10	3 50 per day.....	35 00	20 24	55 24
John J. Allen .....	.....	1	5 00 per day.....	5 00	7 59	12 59
Incidental expenses.						
Telegraph and telephone					\$5 25	
Miscellaneous					7 61	
						12 86
						\$608 87

Improvement Public Highways — Nyack to West Nyack Road, Rockland County.

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze	First assistant engineer....	3	\$6 00 per day.....	\$18 00	\$19 50	\$37 50
Douglas Cornell.....	Assistant engineer.....	9	5 00 per day.....	45 00	45 44	90 44
Frank Roberts.....	Rodman.....	9	3 50 per day.....	31 50	20 32	51 82
H. J. Richardson.....	Chainman.....	9	3 50 per day.....	31 50	20 17	51 67
Incidental expenses.						
Labor.....					\$40 50	
Miscellaneous					53 41	
						\$231 43
						93 91
						\$325 34

Improvement Public Highways—Troy and Greenbush Road.

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. L. Lawton	Assistant engineer.....	10	\$5 00 per day.....	\$50 00	\$12 43	\$62 43
William Van Epps	Chainman.....	16	3 00 per day.....	48 00	24 29	72 29
George McDonald	Chainman.....	2	2 50 per day.....	5 00	3 80	8 80
Parkes D. Wendell.....	Chainman.....	16	3 50 per day.....	56 00	25 44	81 44
James T. Brady.....	Chainman.....	2	2 50 per day.....	5 00	4 92	9 92
						\$234 88

Improvement Public Highways—Northampton Road, Montgomery County.

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. L. Lawton	Assistant engineer.....	7	\$5 00 per day.....	\$35 00	\$14 44	\$49 44
Parkes D. Wendell.....	Chainman.....	5	3 50 per day.....	17 50	11 42	28 92
						\$78 36

Improvement Public Highways—Chester to Middletown Road, Orange County.

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze.....	First assistant engineer.....	1	\$6 00 per day.....	\$6 00	\$5 06	\$11 06
Douglas Cornell.....	Assistant engineer.....	13	5 00 per day.....	65 00	33 64	98 64
F. S. Strong.....	Leveler.....	11	4 50 per day.....	49 50	36 64	86 14
Frank Roberts.....	Rodman.....	11	3 50 per day.....	38 50	29 03	67 53
H. J. Richardson.....	Chainman.....	11	3 50 per day.....	38 50	28 62	67 12
Incidental expenses.						
Labor.....					\$15 00	
Livery.....					55 00	
						70 00
						\$400 49

State Board of Claims.

(Chapter 790, Laws of 1897, and Chapter 604, Laws of 1898.)

(No. 29.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
T. C. Leutze	First assistant engineer.....	109	\$6 00 per day.....	\$654 00	\$712 77	\$1,366 77
John R. Kaley	First assistant engineer.....	3	6 00 per day.....	18 00	25 31	43 31
C. E. Phelps	Assistant engineer.....	116	5 00 per day.....	580 00	247 09	827 09
M. P. Quintana	Assistant engineer.....	45	5 00 per day.....	225 00	21 38	246 38
Derlon Clark.....	Leveler	17	4 50 per day.....	76 50	49 41	125 91
F. S. Strong.....	Leveler	62	4 50 per day.....	279 00	255 27	534 27
W. W. Olney	Leveler	26	4 50 per day.....	117 00	7 96	124 96
Guy H. Miller.....	Leveler	14	4 50 per day.....	63 00	20 52	83 52
James K. Brown	Rodman	29	3 50 per day.....	101 50	24 88	126 38
Frank Roberts	Rodman	15	3 50 per day.....	52 50	49 01	101 51
Parkes D. Wendell.....	Chainman.....	6	2 50 per day.....	15 00	26 64	41 64
George Kirk, Jr.....	Chainman.....	26	2 50 per day.....	65 00	21 38	86 38
James T. Brady.....	Chainman.....	26	2 50 per day.....	65 00	21 38	86 38
H. M. Booth	Chainman.....	14	2 50 per day.....	35 00	7 14	42 14
Frank Lutz	Chainman.....	7	3 00 per day.....	21 00	17 36	38 36
H. J. Richardson.....	Chainman.....	3	3 50 per day.....	10 50	13 68	24 18
L. L. Melius	Chainman.....	7	3 00 per day.....	21 00	19 11	40 11
William Van Epps	Chainman.....	2	3 00 per day.....	6 00	7 64	13 64
John J. Allen .....	.....	9	5 00 per day.....	45 00	86 28	131 28
<i>Incidental expenses.</i>						
Labor.....	.....	.....	.....	.....	\$1,123 75	
Livery.....	.....	.....	.....	.....	55 00	
Telegraph and telephone.....	.....	.....	.....	.....	55 62	
Miscellaneous .....	.....	.....	.....	.....	628 15	
						1,862 52
						\$5,946 73
						\$4,084 21

Examinations and Maps.

(Chapter 790, Laws of 1897, and Chapter 606, Laws of 1898.)

(No. 30.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
C. H. Flanigan.....	Leveler	160	\$5 00 per day.....	\$800 00	.....
E. G. Blessing.....	Rodman	27	3 50 per day.....	94 50	.....
L. K. Devendorf	Rodman	88	3 50 per day.....	308 00	.....	\$1,202 50
Incidental expenses.						
Labor.....					\$2,570 20	
Stationery					8 92	
Miscellaneous					2,899 44	
						5,478 56
						\$6,681 06

Maps Shore Line, Westchester County.

(Chapter 950, Laws of 1896.)

(No. 31.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
C. D. Burrus.....	Draftsman	98	\$4 50 per day.....	\$441 00	.....	\$441 00
C. A. Poole	Draftsman	105	4 00 per day.....	420 00	\$4 58	424 58
Mortimer S. Smith	Rodman.....	131	4 50 per day.....	589 50	16 16	605 66
.						
Incidental expenses.						
Stationery						\$1,471 24
						75 90
						\$1,547 14

Topographic Survey.

(No. 32.)
NAME.

(Chapter 219, Laws of 1898.)

A. M. Walker.....	Amount.
S. Stephens.....	\$609 81
William J. Peters.....	46 00
J. H. Jennings.....	259 75
E. B. Clark.....	671 55
Frank Sutton.....	1,441 72
C. C. Bassett.....	1,880 64
Charles O'Connor.....	1,461 80
W. H. Lovell.....	195 98
W. S. Hodge.....	1,186 28
Clark Brown.....	158 37
Clarence F. Horton.....	297 41
J. H. Wheat.....	239 99
R. D. Gammin.....	1,420 65
L. T. Haney.....	1,920 70
Hersey Monroe.....	193 13
J. W. Thom.....	107 90
John G. Mislin.....	488 18
Walter R. Harper.....	132 00
R. M. Sutton.....	206 05
R. Guy Foster.....	133 33
S. O. Scudder.....	186 67
C. H. Semper.....	238 33
D. E. Baxter.....	191 67
Cleveland Allen.....	253 33
A. Shire Williams.....	139 13
W. R. Coyle.....	126 66
W. N. Brown.....	126 67
H. T. Dickinson.....	138 58
W. S. Lawyer.....	156 66
P. O. Winter.....	332 12
W. A. Powers.....	186 18
W. H. Bump.....	91 50
	33 50

Topographic Survey—(Continued).

NAME.	Amount.
B. N. Congdon.....	\$13 90
Warner W. Gilbert.....	166 67
William R. Simpson.....	96 00
Clinton B. Bailey.....	108 31
E. L. Faison.....	163 25
E. C. Ryan.....	145 81
Fenton Olvert.....	157 00
W. L. Miller.....	416 51
J. N. Hatfield.....	232 16
S. L. Devendorf.....	64 50
George B. McGowan.....	73 00
George H. Gnerdrum.....	110 00
Glen S. Smith.....	704 66
Nat. G. Van Dorn.....	387 11
E. L. McNair.....	1,186 79
James S. Topham.....	32 20
W. F. Hammond.....	188 39
J. E. Duford.....	216 47
A. H. Bumstead.....	48 23
H. D. Humiston.....	60 97
Abner W. Gill.....	146 77
Oliver St. Marie.....	37 56
Byron E. White.....	59 83
A. E. Hornibrook.....	226 00
Carlos Hutchins.....	126 83
R. B. Hunter.....	163 27
M. S. Hungerford.....	277 20
Charles Brady.....	183 00
F. E. Abrams & Co.....	76 68
W. T. Griswold.....	608 76
Farley Gannett.....	40 00
D. A. Call & Son.....	53 51
Ceylon Clark.....	37 00
John V. Clute.....	22 26
Bion H. Kent.....	170 06
M. S. McDiamid.....	55 48

George B. Curtis.....	298 37
Albert Pike.....	78 57
H. A. Paull.....	407 50
James E. Kelley.....	217 75
W. H. O'Brien.....	52 00
W. H. S. Morey.....	58 00
J. A. Vogleson.....	106 00
George Raymond.....	34 00
Frank Baker.....	32 00
W. J. Robinson.....	36 00
Harry W. Powers.....	21 00
F. N. Sanders.....	120 00
James M. Cook, jr.....	100 00
Frank Clute.....	88 63
George S. Watkins.....	50 00
American Pegamoid Co.....	11 10
Total	<u>\$23,817 30</u>

The foregoing tables are summarized as follows :

Ordinary repairs.		
No.		
1..	Erie canal, chapter 435, Laws of 1897.....	\$7,553 62
2..	Champlain canal, chapter 435, Laws of 1897.....	3,951 79
		<hr/>
Extraordinary repairs.		
3..	Erie canal, chapter 947, Laws of 1896; chapter 568, Laws of 1897, and chapter 506, Laws of 1898..	\$3,350 36
4..	Champlain canal, chapter 947, Laws of 1896; chapter 568, Laws of 1897, and chapter 506, Laws of 1898	3,212 58
5..	Improvement Erie canal, chapter 79, Laws of 1895; chapter 794, Laws of 1896, and chapters 43 and 569, Laws of 1897.....	\$65,483 95
6..	Improvement Champlain canal, chapter 79, Laws of 1895; chapter 794, Laws of 1896, and chapters 43 and 569, Laws of 1897.....	90,872 69
7..	Rebuilding Rexford Flats dam, chapter 560, Laws of 1895; chapter 947, Laws of 1896, and chapter 566, Laws of 1897.....	<hr/>
8..	Fourth street bridge, Waterford, chapter 575, Laws of 1897.....	\$917 72
9..	Ship street bridge, Cohoes, chapter 597.....	291 00
10..	Railroad street lift bridge, Little Falls, Laws of 1896.....	419 60
11..	German street bridge, Little Falls, Laws of 1897.....	397 55
12..	River street lift bridge, Fort Plain, Laws of 1896.....	27 98
13..	Glen street bridge, Glens Falls, Laws of 1895, and chapter 795, Laws of 1896.....	141 45
14..	Maple street bridge, Sandy Hill, and chapter 562, Laws of 1897.....	81 92
15..	Canajoharie lift bridge, chapter 562, Laws of 1896.....	156 50
16..	Cemetery culvert, Waterford, chapter 562, Laws of 1896.....	349 96
17..	Culvert over weigh lock outlet, Waterford, chapter 564, Laws of 1896.....	74 89
18..	Barbas Kill stream, chapter 621, Laws of 1896.....	77 65
19..	Drawbridge over Minieango creek, chapter 631, Laws of 1898.....	166 60
20..	Washington Monument Headquarters, Newburgh, chapter 790, Laws of 1897; chapter 606, Laws of 1898	130 29
21..	State road, town of Colton, St. Lawrence county, chapter 606, Laws of 1898.....	10 74
22..	State road, St. Regis Reservation, chapter 932, Laws of 1896	1,999 10
23..	Shinnecock and Peconic canal (piling and protecting), chapter 950, Laws of 1896, and chapter 791, Laws of 1897	130 62
24..	Shinnecock and Great South Bay (dredging), chapter 207, Laws of 1896.....	526 31
		<hr/>
		\$11,505 41

25..	Sea wall at Orient, chapter 838, Laws of 1896.....	23 80	
26..	Building dyke, Neversink river, town of Deepark, chapter 291, Laws of 1897	296 59	
27..	Rebuilding Sarauac dam, chapter 627, Laws of 1898	703 15	7,763 75
28..	<i>Improvement public highways, chapter 115, Laws of 1898.</i>		
	Troy and Schenectady turnpike	\$576 92	
	Lebaun and Pittsfield road.....	608 87	
	Nyack to West Nyack road, Rockland county.....	325 34	
	Troy and Greenbush road.....	234 88	
	Northampton road, Montgomery county.....	78 36	
	Chester to Middletown road, Orange county.....	400 49	2,224 86
29..	<i>Special surveys.</i>		
	Making surveys and maps for State Board of Claims, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.....	\$5,946 73	
30..	Making surveys and maps required by State Engineer and Surveyor, chapter 790, Laws of 1897, and chapter 606, Laws of 1898.....	6,681 06	
31..	Maps shore line Westchester county, chapter 950, Laws of 1896.....	1,547 14	
32..	Geological survey New York State, chapter 320, Laws of 1897, and chapter 219, Laws of 1898.....	23,817 30	37,992 23
	Total.....	\$162,405 83	

Table of Contracts on Eastern Division Completed During the Year Ending September 30, 1898.

(No. 34.)

ERIE CANAL.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	Appropriation.	LEGISLATIVE ACT.		Engineer's estimate at contract prices.	Final estimate.
				Chapter.	Year.		
O. F. Hill.....	Apr. 29, 1897	Drake drawbridge over Wappingers creek, Dutchess county	\$1,500 00	949	1896	\$1,350 00	\$1,341 36
William Coats.....	Aug. 31, 1897	Dam across Racquette river near Raymondville, St. Lawrence county	2,000 00	158	1896	1,817 50	1,919 07
Hilton Bridge Construction Co	Oct. 8, 1897	For removing iron bridge from Railroad street, Ilion, and erecting it on the site of the present Reese road bridge, Frankfort, N. Y. ....	.....	566	1897	1,650 50	1,649 50
Henry Hall	Oct. 11, 1897	For building and completing retaining walls and approaches to the Ship street bridge over the Champlain canal in the city of Cohoes	6,000 00	778	1897	3,562 20	3,767 11
Monty, Higley & Barber. Jan.	8, 1898	For protecting berms bank of Glens Falls feeder by vertical cement wall and change bridge	2,887 93	566 578	1897 1897	11,095 00	11,984 92
P. J. Brummelkamp....	Dec. 7, 1896	For deepening channel from Shinnecock to Great South bay, town of Southampton, county of Suffolk, N. Y.	10,000 00	348 790	1896 1897	4,220 00	8,481 75
John Twomey	Mar. 11, 1898	New berm abutment to be erected at bridge No. 156, between Ilion and Frankfort, N. Y.	9,000,000 00	79 794 43 & 569	1895 1896 1897	4,938 55	5,036 31
Monty & Higley	Mar. 28, 1896	For constructing a steel bridge, No. 7 (Weavers), railings and berm approach; and a berm tower on the three-mile level canal, about 3,700 feet north of lock 6....	9,000,000 00	79 794 43 & 569	1896 1896 1897	2,111 25	2,350 87

C. J. Reardon & Co.....	Nov. 8, 1897	For rebuilding arch culvert No. 12, located about 1,420 feet south of lock 13, and the Moses Kill Aqueduct, located about 300 feet north of lock 14, on the Champlain canal	9,000,000 00	{ 79 1895 } { 794 1896 } { 43 & 569 1897 }	33,748 20	35,367 73
Shear & Haight.....	Nov. 11, 1896	For the improvement of the Eastern Division of the Erie canal, from lock 22 to bridge 55, a distance of 3.29 miles	9,000,000 00	{ 79 1895 } { 794 1896 } { 43 & 569 1897 }	79,320 50	92,937 29
Thomas H. Karr.....	Sept. 23, 1897	For the improvement of the Eastern Division of the Erie canal, from lock 29 to lock 30, a distance of 0.67 mile	9,000,000 00	{ 79 1895 } { 794 1896 } { 43 & 569 1897 }	9,122 50	12,756 33
Thomas H. Karr.....	Sept. 23, 1897	For the improvement of the Eastern Division of the Erie canal from lock 19 to lock 20, a distance of 2.71 miles	9,000,000 00	{ 79 1895 } { 794 1896 } { 43 & 569 1897 }	65,812 00	72,049 68
Gallo & McNiece	Nov. 9, 1896	For the improvement of the Eastern Division of the Erie canal from lock 28 to lock 29, a distance of 1.97 miles	9,000,000 00	{ 79 1895 } { 794 1896 } { 43 & 569 1897 }	31,590 05	55,206 43
John W. Flynn.....	Nov. 11, 1897	For the improvement of the Champlain canal from lock 5 to lock 6, a distance of 1,400 feet, and from lock 7 to lock 8, a distance of 1.32 miles	9,000,000 00	{ 79 1895 } { 794 1896 } { 43 & 569 1897 }	26,087 50	31,020 33
John W. Whalen	Nov. 10, 1896	For the improvement of the Eastern Division of the Erie canal from lock 20 to lock 21, a distance of 3.22 miles	9,000,000 00	{ 79 1895 } { 794 1896 } { 43 & 569 1897 }	52,910 50	80,845 20
Havana Bridge Works..	Sept. 30, 1897	For a steel bridge over the side cut of the Champlain canal, at the foot of Fourth street, in the village of Waterford	4,000 00	575 1897	3,506 75	3,641 36
Havana Bridge Works..	Nov. 9, 1897	For building a lift bridge over the Erie canal at River street, Fort Plain	14,000 00	576 1897	10,351 30	11,242 75

Table of Contracts Pending on the Eastern Division, September 30.

(No. 35.)

ERIE CANAL.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	Appropriation.	LEGISLATIVE ACT		Engineer's preliminary estimate	Engineer's estimate at contract prices.	Payments to date.
				Chapter.	Year.			
Rochester Bridge & Iron Wks..	Nov. 16, 1895	New iron bridge and abutments at German street, Little Falls, N. Y.....	{ \$8,000 00 4,946 50	{ 680 572	{ 1895 1897	{ \$7,104 50	{ \$7,445 40	{ \$8,035 00
Hilton Bridge Construction Co. Whalen & Higgins	July 28, 1897 Sept. 14, 1897	Lift bridge, Railroad street, Ilion, N. Y. Rebuilding apron and repairing dam across Mohawk river at Rexford Flats, N. Y.....	{ 18,080 00 9,424 00 7,644 00 18,149 48 (Agreement.)	{ 105 947 566 572 791	{ 1897 1896 1897 1897 1897	{ 15,839 00 30,218 00	{ 18,678 20 25,981 50	{ 11,781 00 25,160 00 3,825 00
P. J. Brummelkamp.....	Aug. 28, 1897	Repairs to Shinnecock and Peconic canal.						
Lauer & Haganan.....	Nov. 17, 1896	For the improvement of the Eastern Division of the Erie canal from lock 27 to lock 28, a distance of 5.21 miles..	{ 9,000,000 00	{ 79 794 { 43 & 569	{ 1895 1896 1897	{ 75,028 00	{ 74,159 35	{ 118,423 00
Brummelkamp, Lane & Co....	Nov. 16, 1896	For the improvement of the Eastern Division of the Erie canal from lock 32 to lock 33, a distance of 5.11 miles..	{ 9,000,000 00	{ 79 794 { 43 & 569	{ 1895 1896 1897	{ 90,532 65	{ 88,434 85	{ 119,709 00
Lauer & Haganan	Nov. 17, 1896	For the improvement of the Eastern Division of the Erie canal from lock 33 to lock 34, a distance of 2.57 miles..	{ 9,000,000 00	{ 79 794 { 43 & 569	{ 1895 1896 1897	{ 45,080 50	{ 43,831 25	{ 59,976 00
Mahan & Sunstrom.....	Nov. 12, 1896	For the improvement of the Champlain canal between lock 15 and lock 16, a distance of 11.75 miles.....	{ 9,000,000 00	{ 79 794 { 43 & 569	{ 1895 1896 1897	{ 245,188 76	{ 214,317 52	{ 219,375 00
John V. Quackenbush.....	Sept. 21, 1896	For the improvement of the Eastern Division of the Erie canal from lock 45 to the east line of Oneida county, a distance of 6.77 miles.....	{ 9,000,000 00	{ 79 794 { 43 & 569	{ 1895 1896 1897	{ 225,885 00	{ 181,998 00	{ 74,675 26
Troy Public Works Co.....	Sept. 16, 1897	For the improvement of the Eastern Division of the Erie canal from lock 25 to lock 27, a distance of 6.59 miles..	{ 9,000,000 00	{ 79 794 { 43 & 569	{ 1895 1896 1897	{ 149,280 00	{ 132,678 00	{ 92,979 00
Lauer & Haganan	Oct. 13, 1897	For the improvement of the Eastern Division of the Erie canal, from lock 24 to lock 26, a distance of 3.8 miles...	{ 9,000,000 00	{ 79 794 { 43 & 569	{ 1895 1896 1897	{ 91,905 00	{ 97,301 00	{ 76,430 70

Clinton Beckwith	Sept. 21, 1897	For the improvement of the Eastern Division of the Erie canal, from lock 40 to lock 41, a distance of 2.64 miles..	9,000,000 00	{ 43 & 569 } 79 1895	{ 68,208 50 }	53,000 00	13,545 40
John V. Quackenbush.....	Sept. 21, 1897	For the improvement of the Eastern Division of the Erie canal, from lock 41 to lock 42, a distance of 2.86 miles..	9,000,000 80	{ 43 & 569 } 79 1895	{ 73,450 50 }	59,290 50	56,189 00
Clinton Beckwith.....	Sept. 21, 1897	For the improvement of the Eastern Division of the Erie canal, from lock 39 to lock 40, a distance of 2.76 miles..	9,000,000 00	{ 43 & 569 } 79 1895	{ 94,489 00 }	69,829 00	53,912 80
Pulford & Compton.....	Nov. 8, 1897	For the improvement of the Champlain canal, from lock 20 to lock 21, a distance of 5.44 miles	9,000,000 00	{ 43 & 569 } 79 1895	{ 85,570 00 }	64,249 50	36,297 00
Baker, Banker, Hingston & Co.	Nov. 11, 1897	For the improvement of the Champlain canal, from lock 17 to lock 20, a distance of 6.8 miles	9,000,000 00	{ 43 & 569 } 79 1895	{ 38,294 00 }	34,017 00	18,425 80
E. W. Wicks.....	June 14, 1898	For dredging the canal between Shinnecock and Great South Bay, town of Southampton, county of Suffolk, N. Y.	10,000 00	207 1898	8,500 00	5,440 00	2,448 00

LIST OF BENCH MARKS ON EASTERN DIVISION, NEW YORK STATE CANALS.

The elevation above canal bottom refers to the old C. B. before the improvement of 1895.

[T. W. = Mean low water in Hudson river at Albany, as established by the United States Engineering Corps in 1873. Canal bottom is taken as elevation of lower miter-sill of upper lock on the several levels.]

ANNUAL REPORT OF THE

No	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
1	On shelf at lower end of pier between locks at lock No. 1, marked ⊕ with chisel.....	.....	+ 9.488
2	Lower miter-sill, lock No. 1	+ 0.000	- 7.443
3	The coping of lock No. 1 .....	.....	.....
4	At station 53½, on towpath abutment Ferry street bridge, on the north stone, lower course, marked ⊕ with chisel	+ 9.524	+17.240
5	At station 82¼, on towpath tower of suspension foot bridge, on projection of south cross- sill, marked ⊕ with knife (destroyed).....	.....	.....
6	Lower miter-sill, lock No. 2 (at heel of S. W. gate, W. lock)	+ 0.000	+ 7.716
7	At station O, on coping of lock No. 2, between ends of anchor of S. W. gate of W. lock, marked ⊕-BM with chisel	+18.000 lower level } " 8.505 upper level	" 25.716
8	At station 39, on N. end towpath parapet of culvert, marked ⊕-BM with chisel .....	.....	" 24.494
9	At station 97¼, on N. end towpath parapet of culvert, marked ⊕-BM with chisel.....	+ 7.288	" 25.191
10	At station 156, on S. E. corner of coping on retaining wall of bridge approach, marked ⊕ with chisel	" 7.980	" 27.621
11	At station 166, on N. E. corner towpath parapet of culvert, marked ⊕ with chisel	" 10.410	" 25.754
12	At station 189 on coping of retaining wall at S. end of towpath parapet of culvert, marked ⊕-BM with chisel.....	" 8.543	" 25.277
13	At station 217, on N. end of retaining wall to bridge approach, N. E. corner of coping, marked ⊕-BM with chisel	" 8.066	" 27.617
14	At station 243¼, N. E. corner N. wing of towpath abutment on coping, marked ⊕, and on face of coping BM, with chisel	" 10.406 " 14.574	" 31.785

15	At station 269, on coping of lock on "lower side cut," at anchor of N. W. gate, marked ⊕-BM with chisel.....	" 8.584	" 25.785
16	At station 290, on towpath abutment of arsenal bridge at N. angle of main wall, top of lower course, marked ⊕ and (above) BM with chisel.....	" 11.566	" 28.777
17	At station 320, on towpath abutment of Ferry street bridge, S. E. corner of lower step of wing, marked ⊕ with chisel and (on face of stone) BM.....	" 11.563	" 28.774
18	At station 365, on coping of N. wall, north lock of upper side-cut, N. W. corner of W. stone marked ⊕-BM with chisel.....	" 9.257	" 28.468
19	At station 398½, on N. E. corner towpath parapet of culvert, marked ⊕-BM with chisel.....	" 8.480	" 25.691
20	Lower miter-sill of lock No. 3, at head of S. W. gate of W. lock.....	" 0.000	" 17.211
21	On coping of lock No. 3, between ends of anchor S. W. gate of W. lock, marked ⊕-BM with chisel.....	+20.260 lower level " 9.091 upper level	" 37.471
22	Lower miter-sill of lock No. 4 (at heel of S. W. gate, W. lock).....	+ 0.000	" 28.380
23	On coping of lock No. 4, between ends of anchor S. W. gate, W. lock, marked ⊕-BM with chisel.....	" 20.220 lower level " 8.840 upper level	" 48.600
24	Lower miter-sill, lock No. 5, at heel of S. E. gate, E. lock.....	+ 0.000	" 39.760
25	On coping of lock No. 5, between ends of anchor S. E. gate, E. lock, marked ⊕-BM with chisel.....	" 19.630 lower level " 9.033 upper level	" 59.390
26	Lower miter-sill, lock No. 6, at heel of S. W. gate, W. lock.....	+ 0.000	" 50.357
27	On coping of lock No. 6, between ends of anchor, S. W. gate, W. lock, marked ⊕-BM with chisel.....	" 19.000 lower level " 8.927 upper level	" 69.357
28	Lower miter-sill, lock No. 7, at heel of S. E. gate, E. lock.....	+ 0.000	" 60.430
29	On coping, lock No. 7, between ends of anchor, S. E. gate, E. lock, marked ⊕-BM with chisel.....	" 18.580 lower level " 8.649 upper level	" 79.010
30	Lower miter-sill, lock No. 8, at heel of S. W. gate, W. lock.....	+ 0.000	" 70.361
31	On coping, lock No. 8, between ends of anchor, S. W. gate, W. lock, marked ⊕-BM with chisel.....	" 18.885 lower level " 8.340 upper level	" 89.246
32	Lower miter-sill, lock No. 9, at heel of S. E. gate, E. lock.....	+ 0.000	" 80.906
33	On coping, lock No. 9, between ends of anchor, S. E. gate, E. lock, marked ⊕-BM with chisel.....	" 18.500 lower level " 9.092 upper level	" 99.406
34	Lower miter-sill, lock No. 10, at heel of S. W. gate, W. lock.....	+ 0.000	" 90.314
35	On coping, lock No. 10, between ends of anchor, S. W. gate, W. lock, marked ⊕-BM with chisel.....	" 19.000 lower level " 8.638 upper level	" 109.314
36	Lower miter-sill, lock No. 11, at heel of S. W. gate, W. lock.....	+ 0.000	" 100.676

LIST OF BENCH MARKS ON EASTERN DIVISION, NEW YORK STATE CANALS—(Continued).

No.	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
37	On coping, lock No. 11, between ends of anchor, S. W. gate, W. lock, marked ⊕-BM with chisel	+ 18.650 lower level	+119.326
38	Lower miter-sill, lock no. 12, at heel of S. W. gate, W. lock	" 9.029 upper level	" 110.297
39	On coping, lock No. 12, between ends of anchor, S. W. gate, W. lock, Marked ⊕-BM with chisel	+ 0.000	" 129.387
40	Lower miter-sill, lock No. 13, at heel of S. E. gate, E. lock	" 19.090 lower level	" 120.193
41	On coping, lock No. 13, between ends of anchor, S. E. gate, E. lock, marked ⊕-BM with chisel	" 9.194 upper level	" 139.293
42	Lower miter-sill, lock No. 14, at heel of S. E. gate, E. lock	+ 0.000	" 130.548
43	On coping, lock No. 14, between ends of anchor, S. E. gate, E. lock, marked ⊕-BM with chisel	" 18.700 lower level	" 149.248
44	Lower miter-sill, lock No. 15, at heel of S. E. gate, E. lock	" 8.668 upper level	" 140.580
45	On coping, lock No. 15, between ends of anchor, S. E. gate, E. lock, marked ⊕-BM with chisel	+ 0.000	" 159.380
46	Lower miter-sill, lock No. 16, at heel of S. E. gate, E. lock	" 18.800 lower level	" 150.413
47	On coping, lock No. 16, between ends of anchor, S. E. gate, E. lock, marked ⊕-BM with chisel	" 8.967 upper level	" 169.333
48	Lower miter-sill, lock No. 17, at heel of S. W. gate, W. lock	+ 0.000	" 160.458
49	On coping, lock No. 17, between ends of anchor, S. W. gate, W. lock, marked ⊕-BM with chisel	" 18.920 lower level	" 179.478
50	Lower miter-sill, lock No. 18, at heel of S. W. gate, W. lock	" 8.875 upper level	" 170.745
51	On coping, lock No. 18, between ends of anchor, S. W. gate, W. lock, marked ⊕-BM with chisel	0.000	" 189.785
52	At station 18½, on coping of south abutment of waste-weir on towpath, marked ⊕-BM with chisel	" 19.020 lower level	" 190.029
53	At station 57¼, on N. end berme abutment (wing) of bridge, marked ⊕-BM with chisel	" 8.733 upper level	" 191.150
		+ 9.035	
		" 10.156	

54	At station 123½, S. E. corner coping, N. wing berme abutment of farm bridge, marked ⊕-BM with chisel.....	" 15.526	" 196.526
55	At station 128½, on N. end towpath abutment of farm bridge, on projection of fifth stone from top on N. end of wing, marked ⊕ and on stone above BM with chisel.....	" 12.024	" 193.018
57	At station 168½, on top of coping of S. wing, at end of towpath abutment of farm bridge, marked ⊕-BM with chisel.....	" 11.143	" 192.137
58	At station 169½, on top of coping of N. wing, at end berme abutment of farm bridge, marked ⊕-BM with chisel.....	" 11.461	" 192.455
59	At station 220½, on top of coping, S. W. corner S. E. wing of aqueduct, marked ⊕-BM with chisel.....	" 13.308	" 194. ■■■
60	At station 238, on top of coping N. W. corner N. W. wing of aqueduct, marked ⊕-BM with chisel.....	" 13.189	" 194.183
61	At station 340, on projection on face of first stone under coping, east wing towpath abutment, marked ⊕-BM with chisel.....	" 11.552	" 192.546
62	At station 340, at center of towpath abutment, on face of sixth course under coping, marked BM-⊕ with chisel.....	" 10.176	" 191.170
64	At station 432½, on projection on sixth course below coping, near center towpath abutment, marked BM-⊕ with chisel.....	" 9.949	" 190. ■■■
65	At station 461, on rock at rear of towpath, marked ⊕-BM.....	" 11.158	" 192.152
66	At station..... course below coping, near W. angle face of towpath 1 BM-⊕ with chisel.....	" 11.079	" 192.073
67	At station..... ath abutment of first bridge W. of Clute's drydock, marked ⊕-BM with chisel.....	" 11.294	" 192.288
68	At station 543, on face of towpath abutment, second bridge W. of Clute's drydock, sixth course below coping near E. ■■■	" 10.900	" 191.894
69	At station 568, on face towpath f Clute's drydock, fifth course below coping near W. angle, marked BM-⊕ with chisel.....	" 10.969	" 191.953
70	At station..... face towpath abutment, road bridge at Whitehead's dock, on sixth course at center of abutment, marked BM-⊕ with chisel.....	" 9.529	" 190.523
71	At station..... face towpath abutment of farm bridge, near center on projection of foot- below coping, marked BM-⊕.....	" 8.163	" 189.157
72	At station..... face towpath abutment of second bridge E. of lock 19, on projection on f coping near E. angle, marked ⊕-BM with chisel.....	" 9.710	" 190.704
73	At station 693½, on top of E. corner first stone under coping, E. wing of towpath abutment of first bridge E. of lock 19, marked ⊕ (on top) BM (on face) with chisel.....	" 11.753	" 192.743
74	Lower miter-sill, lock No. 19, at heel of N. E. gate of S. lock (pier wall).....	" 0.000	" 180. ■■■
75	On coping lock No. 19, near ends of anchor N. E. gate, S. lock (pier wall), marked ⊕-BM with chisel.....	{ +17.22 lower level + 8.779 upper level	

LIST OF BENCH MARKS ON EASTERN DIVISION, NEW YORK STATE CANALS—(Continued).

No.	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
76	At station 70, on N. corner of coping, at end of W. wing of towpath abutment, road bridge	+12.119	+201.554
77	Vischer's Ferry, marked (on top) ⊕ and (on face) ⊕-BM with chisel	" 10.713	" 200.148
79	At station 140, on rock, cut on rock at rear of towpath, marked BM-⊕ with chisel	" 0.000	" 189.435
80	Lower miter-sill, lock No. 20, at heel of N. E. gate, N. lock	+18.680 lower level " 8.242 upper level	" 203.085
81	On coping, lock No. 20, at ends of anchor, N. E. gate, N. lock, marked ⊕-BM with chisel	+12.710	" 212.563
82	At station 108½, above lock No. 20, on top of coping at E. end of wing berme abutment, road	" 0.000	" 199.853
83	bridge at Fonda's basin, marked ⊕ and (on face) BM with chisel	+19.720 lower level " 8.594 upper level	" 219.573
84	Lower miter-sill, lock No. 21, at heel of S. E. gate, S. lock	+0.000	" 210.979
85	On coping, lock No. 21, at ends of anchor, S. E. gate, S. lock, marked ⊕-BM with chisel	+20.180 lower level " 8.571 upper level	" 231.159
86	Lower miter-sill, lock No. 22, at heel of N. E. gate, N. lock	+ 9.418	" 232.006
87	On coping, lock No. 22, near ends of anchor, N. E. gate, N. lock, marked ⊕-BM with chisel	" 13.089	" 235.577
88	At station 6½, on N. E. corner of coping on end of towpath wing, N. end of upper Mohawk	" 12.928	" 235.516
89	aqueduct, marked ⊕, and on face of stone BM with chisel	" 8.556	" 231.144
90	At station 16, on top of coping, near end of parapet, towpath wing; south end of aqueduct ⊕, and on stone near it ⊕-BM, with chisel	" 10.673	" 233.261
91	At station 24½, on north wing of berme abutment of first road bridge west of aqueduct, top	" 11.031	" 233.619
92	of coping marked ⊕, and on face of stone BM with chisel	" 10.208	" 232.796
93	At station 143, on face of towpath abutment, Vedler's bridge, projection on lower course	" 11.783	" 234.871
94	near W. angle, marked ⊕, and on stone above BM with chisel		
95	At station 161½, on face of towpath abutment of farm bridge near center projection of		
96	sixth course under coping, marked BM-⊕ with chisel		
97	Station 210, on face of towpath abutment of R. R. bridge, on stone near W. end, about 2½		
98	in, above joint, marked BM-⊕ with chisel		
99	Station 220½, on top of coping on end of W. wing berme abutment road bridge, marked		
100	⊕-BM (on top of		
101	end of E. wing of towpath abutment of road bridge, marked		
102	with chisel		
103	⊕, and on face of		

94	Station 284, on top of coping on end of E. wing of berme abutment of Front street bridge, marked ⊕, and on face of stone BM, with chisel	" 10.189	" 232.777
95	Station 311, on S. W. corner of coping of retaining wall E. of street bridge, marked ⊕, and on face of stone BM, with chisel	" 13.695	" 236.283
96	Station 337, on third step from bottom at E. end of towpath abutment, State street bridge, marked ⊕, and on end of step BM, with chisel	" 12.014	" 234.602
97	Station 368½, on top of coping, S. W. corner of parapet of waste-weir, marked ⊕, and (on face) BM, with chisel	" 11.630	" 234.218
98	Station 504½, near center of face of towpath abutment of bridge at Navonier's Bay, on projection of sixth course below coping, marked ⊕, and on stone above BM, with chisel	" 9.324	" 231.912
99	Lower miter-sill of lock No. 23, at heel of N. E. gate, N. lock	" 0.000	" 222.588
100	On top of coping, lock No. 23, at end of anchor N. E. gate, N. lock, marked ⊕—BM with chisel.	{ +16.900 lower level " 8.582 upper level	" 239.488
101	Station 9, on face of towpath abutment of farm bridge near W. angle on projection of sixth course below coping marked ⊕, and on stone above BM, with chisel		" 240.021
102	Lower miter-sill of lock No. 24, at heel of N. E. gate, N. lock	+ 9.115 " 0.000	" 230.906
103	On coping of lock No. 24, at end of anchor N. E. gate, N. lock, marked ⊕—BM with chisel...	{ " 16.860 lower level " 8.669 upper level	" 247.766
104	Station 49½, on face of towpath abutment of road bridge, on projection of course below coping, marked ⊕, and on stone above BM, with chisel		" 250.634
105	Station 99½, on face of towpath abutment of farm bridge, on projection on sixth course below coping, near E. angle, marked BM-⊕ (on the stone) with chisel	" 10.020	" 249.117
106	Station 113+88, on E. end of Flat Stone Creek aqueduct, towpath side abutment, 6 in. east of junction of wing and straight wall at foot of parapet, marked ⊕, and (on face of coping of parapet above it) BM with chisel	" 9.203	" 248.300
107	Station 181½, near center of face of towpath abutment of road bridge, on projection of sixth course below coping, marked BM-⊕ with chisel	" 11.372	" 250.469
108	Station 218, near W. angle face of towpath abutment of farm bridge, on projection of seventh course below coping, marked ⊕, and on stone above BM with chisel	" 10.597	" 249.684
109	Station 284½, at center of face of towpath abutment, first bridge below lock No. 25, on projection of footing course (seventh below coping), marked ⊕, and on stone above BM with chisel	" 8.873	" 247.972
110	Lower miter-sill of lock No. 25, at heel of N. E. gate, N. lock, marked ⊕	" 0.000	" 239.097
111	On coping of lock 25, at end of anchor, N. E. gate, N. lock, marked ⊕—BM with chisel	{ +16.655 lower level " 8.949 upper level	" 255.762
112	Station 40½, on corner of coping, end of W. wing towpath abutment of farm bridge, marked ⊕ (on top) and BM (on face) with chisel		" 258.344
113	Station 74, on face towpath abutment farm bridge (near W. angle), on projection of fourth course below coping, marked ⊕, and on stone above BM with chisel	+11.531 " 12.321	" 259.134

LIST OF BENCH MARKS ON EASTERN DIVISION, NEW YORK STATE CANALS—(Continued).

No.	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
114	Station 118, on coping, end of W. wing berme abutment of read bridge marked ⊕-BM with chisel	+11.530	+258.343
115	Station 171, on coping of parapet Sansai Kill aqueduct, at E. angle (junction of wing with straight wall), marked ⊕-BM with chisel.....	" 12.650	" 259.463
116	Station 253+80, on small granite boulder rear of towpath (is about fifty feet east of line of stone fence between orchard and corn field on hill across canal), marked ⊕-BM with chisel	" 8.386	" 255.199
117	Station 285½, on flat, white rock at N. angle of towpath, opposite the middle of the bay, below lower end of rock bluff on berme, marked ⊕-BM with chisel.....	" 8.747	" 255.560
118	Station 347, on flat sand stone at rear towpath and at west end of first course below Swarts' bridge, marked ⊕-BM with chisel.....	" 8.223	" 255.036
119	Station 360½, on parapet of culvert (berme side) of N. W. corner of coping, marked ⊕-BM with chisel.....	" 1.240	" 248.053
120	Station 398½, on top of stone under coping, on E. wing of towpath abutment of Klein's bridge, marked ⊕ (on face) and BM with chisel.....	" 12.485	" 259.298
121	Station 460, on coping E. wing towpath abutment of farm bridge, marked ⊕, and on face BM, with chisel.....	" 12.492	" 259.305
122	Lower miter-sill, lock No. 26, at heel of N. E. gate, N. lock, marked ⊕-BM.....	" 0.000	" 246.813
123	On coping, lock No. 26 at end of anchor, N. E. gate N. lock, marked ⊕-BM with chisel....	+16.870 lower level	" 263.683
124	Lower miter-sill, lock No. 27, at heel of N. E. gate, N. lock.....	" 8.505 upper level	" 255.178
125	On coping of lock No. 27, at end of anchor, N. E. gate, N. lock, marked ⊕-BM with chisel...	+0.000	" 271.608
126	Station 61½, on retaining wall over berme end of culvert, 5 in. west of center line, marked ⊕ with chisel.....	" 16.430 lower level	" 266.543
127	Station 96½, on towpath end of culvert at top of sloping coping, at E. corner of second stone from E. side, marked ⊕-BM with chisel.....	" 8.544 upper level	" 265.273
128	Station 163½, on coping of waste-weir near N. W. corner of top of E. wall marked ⊕-BM with chisel.....	" 2.109	" 271.887
129	Station 203½, on top of lower step at W. end towpath abutment of street bridge (east bridge at Port Jackson), marked ⊕-BM with chisel.....	" 8.723	" 279.445
		" 16.281	

130	Station 225½, on top of coping at center pier of Port Jackson creek culvert (T. P. side), marked ⊕, and (on slope) BM with chisel.....	+ 0.344	+263.508
131	Lower miter sill, lock No. 28, at heel of S. E. gate, S. lock, marked ⊕-BM.....	" 0.000	" 263.164
132	On top of coping, lock No. 28, at end of anchor, S. E. gate, S. lock, marked ⊕-BM with chisel.....	+16.870 lower level " 9.147 upper level	" 280.084
133	Station 85½, at E. end of towpath abutment, farm bridge, on top of third stone above ground, marked ⊕, and (on face) BM with chisel.....	+12.269	" 283.148
134	Station 138, on center face of towpath abutment, farm bridge, on projection of sixth stone below coping, marked ⊕-BM with chisel.....	" 11.717	" 283.604
135	Lower miter-sill, lock No. 29, at heel of N. E. gate, N. lock.....	" 0.000	" 270.887
136	On coping lock No. 29, at end of anchor, N. E. gate, N. lock, marked ⊕-BM with chisel.....	"17.020 lower level " 9.621 upper level	" 287.907
137	Station 30 on face of towpath abutment of farm bridge, on projection of 4th stone below coping, near E. angle, marked ⊕-BM with chisel.....	+12.491	" 290.777
138	Lower miter-sill, lock No. 30, at heel of N. E. gate, N. Lock.....	" 0.000	" 278.266
139	On coping, lock No. 30, at end of anchor, N. E. gate, N. lock, marked.....	"19.370 lower level " 9.157 upper level	" 297.656
140	Station 18½, at foot of parapet, at end of W. wing, towpath side of Schoharie creek aqueduct, marked ⊕, and on parapet above BM, with chisel.....	+10.205	" 298.704
142	Station 123½, top of lower step, W. wing, berme abutment of farm bridge, marked ⊕ and BM (on end of stone) with chisel.....	" 13.411	" 301.910
143	Station 152½, on face of towpath abutment, near E. angle on projection of 5th course below coping, marked ⊕, and (on stone above) BM, with chisel.....	" 11.889	" 300.398
144	Station 181½, on face towpath abutment of farm bridge, on projection of 6th course below coping, near W. angle, marked ⊕, and (on stone above) BM, with chisel.....	" 11.595	" 300.094
145	Station 253½, on face of towpath abutment of farm bridge, near E. angle on projection of 5th course below coping, marked ⊕, and (on stone above) BM, with chisel.....	" 11.474	" 300.883
146	Station 281, on face of towpath abutment of covered 1 near west angle of projec- tion of 4th stone below coping, marked ⊕, and (on 1) BM, with chisel.....	" 12.070	" 300.569
147	Station 308½, top of lower step of W. wing, berme abutment of farm bridge, marked ⊕-BM, with chisel.....	" 13.485	" 301.884
148	Station 345½, on top of lower step, E. wing berme abutment of farm bridge, marked ⊕ with chisel.....	" 11.928	" 300.427
149	Station 394, on top of lower step, W. wing of berme abutment, marked ⊕ with chisel.....	" 11.331	" 299.890
150	Station 482½, on top of coping at end of E. wing of towpath abutment of farm bridge, marked ⊕, and (on face of stone) BM, with chisel.....	" 12.717	" 301.216
151	Station 539, on face of towpath abutment of farm bridge near E. angle on projection of 4th course below coping, marked ⊕-BM with chisel.....	" 11.369	" 299.849

LIST OF BENCH MARKS ON EASTERN DIVISION, NEW YORK STATE CANALS—(Continued).

No.	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
152	Station 613, on face of top stone, end of W. wing, towpath abutment of farm bridge, on projection of stone, marked ⊕-BM with chisel	+11.896	+300.385
153	Station 664½, on top of coping at end of E. wing of Tokkon creek aqueduct, towpath side, marked ⊕-BM with chisel	" 8.024	" 298.523
154	Station 737, on face of towpath abutment of farm bridge, near E. angle on projection of 4th stone below coping, marked ⊕-BM with chisel	" 10.856	" 299.355
155	Station 813½, on top of second stone below coping, at end of E. wing of berme abutment of farm bridge at Yatesville, marked ⊕ and (on stone above) BM, with chisel	" 10.594	" 299.093
156	Station 846½, on top of coping, N. E. corner N. E. wing of Leonardson's creek aqueduct, marked ⊕-BM with chisel	" 8.122	" 296.621
157	Station 935, on top of coping of E. abutment of aqueduct, N. W. cor. (towpath side) of main wall, marked ⊕-BM with chisel	" 7.979	" 296.478
158	Station 1,079½, on top of lower step, W. wing berme abutment of farm bridge marked ⊕-BM with chisel	" 12.337	" 300.836
159	Lower miter-sill of lock 31 at heel of N. E. gate, S. lock on (pier side)	" 0.000	" 288.499
160	On coping, lock 31, at end of anchor, N. E. gate S. lock (pier wall), marked ⊕-BM with chisel	{ +14.760 lower level " 8.893 upper level	" 303.259
161	Station 174, on face of towpath abutment, Ferry street bridge, on projection of fifth course below coping (near center, old bench), marked ⊕-BM with chisel	+10.392	" 304.758
162	Station 49½, on face of towpath abutment of farm bridge, projection on fifth course below coping, near W. angle, marked ⊕-BM with chisel	" 11.325	" 305.691
163	face of towpath abutment of farm bridge, projection of sixth course below center, marked BM-⊕ with chisel	" 9.990	" 304.356
164	a face of towpath abutment of farm bridge, on projection of seventh course, near W. angle, marked ⊕-BM with chisel	" 8.824	" 303.190
165	Station 206½, on face of towpath abutment of farm bridge, on projection of fourth course under coping (near center), marked BM-⊕	" 9.573	" 304.239
166	Station 252, on top of coping of parapet at N. E. wing of Plattkill aqueduct (N. E. corner of end stone), marked ⊕ and on face BM with chisel	" 13.194	" 307.560

167	Station 314, on top of coping at end of E. wing towpath abutment of farm bridge, marked ⊕ and (on face) BM with chisel.....	+12.412	+306.778
168	Station 370½, on rear upper corner of first stone under coping at end of W. wing, berm abutment of farm bridge, marked ⊕-BM with chisel.....	" 11.150	" 305.516
169	Station 475½, on towpath abutment of farm bridge, near center of face of E. wing, projection on second stone above ground, marked BM-⊕ with chisel.....	" 10.689	" 305.055
170	Lower miter-sill, lock No. 32 (at heel of N. E. gate, N. lock).....	" 0.000	" 294.366
171	On coping, lock 32, at end of anchor, N. E. gate, N. lock, marked ⊕-BM with chisel.....	+17.110 lower level " 8.984 upper level	" 311.476
172	Station 27½, on front corner, third step from bottom, on E. wing towpath abutment iron street bridge, marked ⊕ and (on end of stone) BM with chisel.....	+11.905	" 314.397
173	Station 60, on top coping at end of W. wing towpath abutment, farm bridge, marked ⊕, and on face BM with chisel.....	" 11.145	" 313.637
174	Station 90, on face of towpath abutment of farm bridge (near center) projection of sixth course below coping, marked ⊕ and (on stone above) BM with chisel.....	" 9.420	" 311.912
175	Station 122, on coping of parapet, towpath end of culvert at center, marked BM-⊕ with chisel.....	" 4.461	" 306.953
176	Station 314½, on corner of coping, E. wing wall of culvert, marked ⊕-BM with chisel.....	" 6.712	" 309.204
177	Station 337, on face of towpath abutment of farm bridge, at W. angle projection on sixth course below coping, marked BM-⊕ with chisel.....	" 10.353	" 312.845
178	Lower miter-sill, lock No. 33 (at heel of N. E. gate, N. lock).....	" 0.000	" 302.492
179	On coping, lock No. 33, at end of anchor of N. E. Gate, N. lock, marked ⊕-BM with chisel..	+14.770 lower level " 9.066 upper level	" 317.262
180	Station 29½, on coping of towpath parapet of culvert (near center) marked ⊕-BM with chisel	+ 2.414	" 310.610
181	Station 65½, on lower step, E. wing towpath abutment of road bridge, marked ⊕, and on face BM. with chisel.....	" 13.439	" 321.635
182	Station 175½, on face of towpath abutment of farm bridge near E. angle projection on fifth course below coping, marked ⊕-BM with chisel.....	" 11.421	" 319.617
183	Lower miter-sill, lock No. 34, at heel of N. E. gate, N. lock.....	" 0.000	" 308.196
184	On coping, lock No. 34, at end of anchor N. E. gate, N. lock, marked ⊕-BM with chisel.....	+17.080 lower level " 8.597 upper level	" 325.276
185	Station 45½, on face of towpath abutment of farm bridge near W. angle projection of seventh course below coping, marked BM-⊕ with chisel.....	+ 8.774	" 325.453
186	Station 94, on face of towpath abutment of road bridge (E. creek landing) near center projection of seventh course below coping, marked ⊕, and (on stone above) BM with chisel..	" 10.912	" 327.591
187	Station 174½, on face of towpath abutment of farm bridge, near W. angle projection of seventh course below coping, marked ⊕, and (on stone above) BM with chisel.....	" 9.829	" 325.508
188	Station 217½, on face of towpath abutment of farm bridge, near center projection of seventh course below coping, marked ⊕-BM with chisel.....	" 9.619	" 326.298

LIST OF BENCH MARKS ON EASTERN DIVISION, NEW YORK STATE CANALS — (Continued).

No.	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
189	Lower miter-sill, lock No. 35, at heel of N. E. gate, N. lock	+0.000	+316.679
190	On coping, lock No. 35, at end of anchor N. E. gate, N. lock, marked ⊕-BM with chisel	{ +16.850 lower level " 9.065 upper level	" 333.529
191	Station 35, at center of face, W. wing towpath abutment, third course above ground, marked ⊕-BM with chisel	+11.233	" 335.697
192	Station 71, on top of coping E. wing berme abutment of farm bridge, marked ⊕-BM with chisel	" 13.826	" 338.290
193	Station 216½, on top of coping E. wing towpath abutment of farm bridge, marked ⊕, and (on face) BM with chisel	" 12.053	" 336.517
195	Lower miter-sill of lock No. 36, at heel of N. E. gate, N. lock	" 0.000	" 324.464
196	On top of coping, lock No. 36 (at E. end of hollow quoin stone), N. E. gate, N. lock, marked ⊕-BM with chisel	{ +18.780 lower level " 8.761 upper level	" 343.244
197	Lower miter-sill of lock No. 37 (at heel of N. E. gate, N. lock)	+0.000	" 334.483
198	On coping, lock No. 37, at end of anchor N. E. gate, N. lock, marked ⊕-BM	{ " 18.790 lower level " 8.892 upper level	" 353.273
199	Lower miter-sill, lock No. 38, at heel of N. E. gate, N. lock	+0.000	" 344.381
200	On coping, lock No. 38, at end of anchor N. E. gate, N. lock, marked	{ " 18.520 lower level " 9.787 upper level	" 362.901
201	Lower miter sill, lock No. 39, at heel N. E. gate, N. lock	+0.000	" 353.114
202	On coping, lock No. 39, at end of anchor N. E. gate, N. lock, marked	{ " 19.830 lower level " 9.306 upper level	" 372.944
203	Destroyed.		
204	Station 97½, on top of coping, end of E. wing towpath abutment of farm bridge, marked ⊕, and on face BM with chisel	+14.010	" 377.648
205	Station 178½, on top of coping, at end of W. wing berme abutment of farm bridge, marked ⊕-BM with chisel	" 14.463	" 378.101
206	Lower miter-sill, lock No. 40, at heel of N. E. gate, N. lock	" 0.000	" 363.638
207	On top of coping, lock No. 40, at end of anchor N. E. gate, N. lock marked	{ " 17.080 lower level " 8.556 upper level	" 380.718
208	Station 73½, on top of stone under coping at end of W. wing towpath abutment of farm bridge, marked ⊕ and (at end of stone) BM with chisel	+12.357	" 384.519

200	Station 125, on top of coping, end of W. wing towpath abutment of bridge, marked ⊕-BM with chisel.....	+13.802	+384.964
210	Station 180½, on top of stone under coping, W. end of towpath abutment of farm bridge (near corner), marked ⊕, and BM (on end of stone) with chisel.....	" 11.914	" 384.076
211	Lower miter-sill of lock No. 41, at heel of N. E. gate, N. lock	" 0.000	" 372.183
212	On coping lock No. 41, at end of anchor N. E. gate, N. lock, marked ⊕-BM with chisel	{ +16.850 lower level	" 389.012
213	Station 30, on top of coping, end of E. wing towpath abutment of farm bridge, marked ⊕-BM with chisel.....	+12.861	" 393.309
214	Station 109, on lower step, E. end of towpath abutment of Herkimer road bridge, marked ⊕ with chisel	" 9.984	" 390.442
215	Station 180½, on footing course at E. end of towpath abutment, street railroad bridge, marked ⊕, and on end of stone above BM with chisel.....	" 9.511	" 389.939
216	Lower miter-sill, lock No. 42, at heel of N. E. gate, N. lock	" 0.000	" 380.448
217	On coping, lock No. 42, at end of anchor N. E. gate, N. lock, marked ⊕-BM with chisel.....	{ " 16.670 lower level	" 397.118
218	Lower miter-sill, lock No. 43, at heel of N. E. gate, N. lock.....	{ " 8.716 upper level	" 388.402
219	On coping, lock No. 43, at end of anchor N. E. gate, N. lock, marked ⊕-BM with chisel.....	{ " 16.500 lower level	" 404.902
220	Station 31, on top of coping at end of E. wing of towpath abutment of farm bridge, marked ⊕-BM with chisel	{ " 8.431 upper level	" 409.025
221	Station 67½ top of coping at end of E. wing towpath abutment of bridge, marked ⊕-BM (on face) with chisel.....	+12.534	" 409.595
223	Station 130, on top of coping of parapet of aqueduct at W. end, marked ⊕, and (on face) BM with chisel.....	" 13.124	" 408.558
224	Station 150½, on top of coping, end of E. wing towpath abutment of farm bridge, marked ⊕, and (on face) BM with chisel.....	" 12.087	" 409.335
225	Station 185½, on lower step on E. end of towpath abutment of road bridge, marked ⊕, and (on face) BM with chisel.....	" 12.864	" 408.243
226	Lower miter-sill, lock No. 44, at heel of N. E. gate, N. lock.....	" 11.773	" 396.471
227	On coping of lock No. 44, at end of anchor, N. E. gate, N. lock, marked ⊕-BM with chisel.....	{ " 0.000	" 416.441
228	Station 45½, at end of E. wing towpath abutment of farm bridge on corner of fourth stone under coping, marked ⊕, and on stone above	+11.808	" 409.016
229	Station 77½, on face of towpath abutment of far	" 11.769	" 418.977
230	top, marked ⊕, and (on stone above) BM with	" 0.000	" 407.208
231	Lower miter-sill, lock No. 45, at heel of N. E. gate, N. lock.....	{ +20.130 lower level	" 427.338
	On coping, lock No. 45, at end of anchor, N. E. gate, N. lock, marked ⊕-BM with chisel.....	{ " 8.958 upper level	

LIST OF BENCH MARKS ON EASTERN DIVISION, NEW YORK STATE CANALS--(Concluded).

No.	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
232	Station 37, on stone under coping, end of E. wing, berme abutment of farm bridge, marked ⊕-BM with chisel.....	+11.534	+429.934
233	Station 74½, at W. end of berme abutment of farm bridge, marked ⊕-BM with chisel.....	" 11.573	" 429.973
234	Station 96½, on top of coping at end of W. wing berme abutment of farm bridge, marked ⊕-BM with chisel.....	" 11.906	" 430.306
235	Station 139½, lower step, W. end of towpath abutment of farm bridge, marked ⊕-BM at every station with chisel.....	" 12.875	" 431.275
236	Station 187½, on lower step, W. end of towpath abutment of farm bridge, marked ⊕, and (on face) BM with chisel.....	" 12.734	" 431.134
237	Station 218, on face of towpath abutment near W. angle on projection of sixth course from top, marked BM-⊕ with chisel.....	" 11.847	" 430.247
238	Station 296½, on face of towpath abutment of farm bridge on projection of seventh course from top near E. angle, marked ⊕-BM with chisel.....	" 11.247	" 429.697
239	Station 328½, on face of W. wing towpath abutment of farm bridge near W. angle projection of seventh course below coping, marked ⊕-BM with chisel.....	" 10.326	" 428.726
240	Station 364, on face of towpath abutment of farm bridge, projection of fifth course below coping, marked ⊕-BM with chisel.....	" 12.737	" 431.137
241	Station 387½, top of lower step at end of W. wing towpath abutment of farm bridge, marked ⊕, and (on face) BM with chisel.....	" 13.307	" 431.707
243	Station 452, on top of coping of parapet, at end of E. wing of towpath side Ferguson creek aqueduct, marked ⊕-BM with chisel.....	" 9.330	" 427.730
244	Station 495½, on lower step, E. wing towpath abutment of farm bridge, marked ⊕-BM with chisel.....	" 11.898	" 430.298
...	Three chains west of Oneida county line (on middle division) on lower step of E. wing towpath abutment of Green bridge, marked ⊕, and (on face) ⊕-BM with chisel.....	" 13.619	" 432.019

LIST OF BENCH MARKS ON CHAMPLAIN CANAL.

No.	LOCATION AND DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
1	Coping, lock No. 1, S. E. gate anchor.....	{ lower level +20.64	+ 37.98
2	Lower miter-sill, lock No. 1.....	{ upper level " 9.25	" 17.34
3	Coping of lock No. 2, S. E. gate anchor.....	{ lower level " 20.61	" 49.34
4	Lower miter-sill, lock No. 2.....	{ upper level " 9.14	" 28.73
5	Coping of lock No. 3, S. W. gate anchor.....	{ lower level " 11.06	" 51.26
6	Lower miter-sill, lock No. 3.....	{ upper level " 10.16	" 40.20
7	Coping, lock No. 4, N. E. gate anchor.....	" 14.20	" 55.30
8	Lower miter-sill, lock No. 4.....	0.00	" 41.10
9	Coping, S. W. recess angle, upper combined lock at Waterford.....	" 7.72	" 48.82
10	Coping, lock No. 5, S. E. gate anchor.....	" 20.92	" 62.02
11	Lower miter-sill, lock No. 5.....	" 7.13	" 40.82
12	Lower miter-sill, lock No. 6.....	" 0.28	" 54.09
13	Coping, lock No. 7, S. E. gate anchor.....	0.00	" 82.94
14	Lower miter-sill, lock No. 7.....	" 17.50	" 65.44
15	Coping, lock No. 8, S. E. gate anchor.....	" 8.27	" 94.64
16	Lower miter-sill, lock No. 8.....	0.00	" 74.67
17	Lower step, S. W. corner towpath abutment, bridge No. 17, marked ⊕.....	" 19.97	" 94.73
18	Lower step, S. W. corner towpath abutment, bridge No. 18, marked ⊕.....	" 8.88	" 96.63
19	S. E. corner (water-table) hosiery mill in Mechanicville.....	0.00	" 96.12
20	Lower step, N. W. corner towpath abutment, bridge No. 23, marked ⊕.....	" 10.36	" 98.40
21	Coping waste-weir, first north of Mechanicville, N. abutment S. E. corner, marked ⊕.....	" 10.64	" 93.52
22	Lower step, N. E. corner berme abutment, bridge No. 24, marked ⊕.....	" 7.76	" 96.20
23	Lower step, S. E. corner towpath abutment, Fitchburgh railroad bridge, marked ⊕.....	" 10.44	" 93.51
24	Coping, lock No. 9, gate anchor.....	" 7.75	" 102.84
		{ lower level " 17.08	
		{ upper level " 8.78	

LIST OF BENCH MARKS ON CHAMPLAIN CANAL—(Continued).

No.	DESCRIPTION.	Elevation C. B. Old datum.	Elevation above T. W.
25	Lower miter-sill, lock No. 9.....	0.00	+ 85.76
26	Lower step, S. E. corner berme abutment, bridge No. 26, marked ⊕.....	+12.69	" 106.75
27	Lower step, N. E. corner berme abutment, bridge No. 27, marked ⊕.....	" 8.64	" 102.70
28	Third step from top S. E. corner berme abutment, bridge No. 28, marked ⊕.....	" 14.98	" 109.04
29	Coping, Lansing's waste-weir, south end east stone, marked ⊕.....	" 9.21	" 103.27
30	Coping, Lansing's waste-weir, north end east stone.....	" 9.01	" 103.07
31	Lower step, S. W. corner towpath abutment, bridge No. 32, marked ⊕.....	" 9.77	" 103.83
32	Third stone from south end, second course towpath abutment, bridge No. 33, marked ⊕.....	" 9.58	" 103.64
33	Lower step, N. E., corner berme abutment, bridge No. 36, marked ⊕.....	" 11.91	" 105.97
34	Middle abutment, Bemis Heights, waste-weir, S. E. corner marked ⊕.....	" 9.94	" 104.00
35	Second step from bottom, N. E. corner berme abutment, bridge No. 40, marked ⊕.....	" 10.95	" 105.01
36	Coping, Wilber's basin waste-weir, south end N. E. corner, marked ⊕.....	" 8.47	" 102.53
37	Coping, waste-weir No. 7, north end S. E. corner, marked ⊕.....	" 9.81	" 103.87
38	Second step from bottom, N. E. corner berme abutment, bridge No. 52, marked ⊕.....	" 13.03	" 107.09
39	Coping, Coveville waste-weir, south end N. E. corner, marked ⊕.....	" 9.14	" 103.20
40	BM on nail in root of ash tree, 150 feet south of old abutment on abandoned canal at Coveville improvement.....	" 9.11	" 103.17
41	Lower step, N. W. corner towpath abutment, bridge No. 57, marked ⊕.....	" 13.76	" 107.82
42	Second step from bottom, N. W. wing wall T. P. abutment, bridge No. 61, Ferry street, Schuylerville.....	" 12.65	" 106.71
43	Lower step, S. W. corner towpath abutment, bridge No. 62, marked ⊕.....	" 12.47	" 106.53
44	Second step from bottom, N. W. corner towpath abutment, bridge No. 63, marked ⊕.....	" 13.66	" 107.72
45	Lower step, S. W. corner towpath abutment, bridge No. 64, marked ⊕.....	" 13.95	" 108.01
46	Coping, lock No. 10, S. E. gate anchor.....	" 15.64	" 109.70
47	Lower miter-sill, lock No. 10.....	0.00	" 94.06
48	Coping, lock No. 11, S. E. gate anchor.....	" 9.11	" 113.00
49	Lower step, S. W. corner berme abutment, bridge No. 67, marked ⊕.....	" 10.92	" 114.81
50	Lower step, N. W. corner berme abutment, bridge No. 68, marked ⊕.....	" 12.72	" 116.61
51	Coping, lock No. 12, S. E. gate anchor.....	" 18.00	" 121.89
52	Lower miter-sill, lock No. 12.....	" 8.42	" 103.89
		{ lower level	
		{ upper level	
		0.00	

53	Lower step, N. W. corner berme abutment, bridge No. 71, marked ⊕		+ 8.78	+122.25
54	Lower step, N. W. corner berme abutment, bridge No. 72, marked ⊕		" 9.20	" 122.67
55	Lower step, N. E. corner berme abutment, bridge No. 74, marked ⊕		" 9.77	" 123.24
56	Coping, lock No. 13, S. W. gate anchor	{ lower level	" 19.05	" 132.52
57	Lower miter-sill, lock No. 13	{ upper level	" 9.23	" 113.47
58	Lower step, N. W. corner berme abutment, bridge No. 76, marked ⊕		0.00	" 133.26
59	Lower step, N. W. corner berme abutment, bridge No. 78, marked ⊕		" 9.97	" 133.24
60	Lower step, N. W. corner berme abutment, bridge No. 79, marked ⊕		" 9.95	" 133.56
61	Lower step, N. W. corner berme abutment, bridge No. 81, marked ⊕		" 10.27	" 134.20
62	Lower step, S. corner berme abutment, bridge No. 81, marked ⊕		" 10.91	" 137.50
63	Lower step, W. corner berme abutment, bridge No. 82, marked ⊕		" 14.21	" 141.25
64	Coping, lock No. 14, S. E. gate anchor	{ lower level	" 17.96	" 123.29
65	Lower miter-sill, lock No. 14	{ upper level	" 8.71	" 145.07
66	Lower step, W. corner berme abutment, bridge No. 84, marked ⊕		0.00	" 143.01
67	Lower step, S. corner berme abutment, bridge No. 85, marked ⊕		" 12.53	" 142.62
68	Lower step, S. W. corner berme abutment, bridge No. 86, marked ⊕		" 10.47	" 142.70
69	Lower step, S. W. corner berme abutment, bridge No. 87, marked ⊕		" 10.08	" 142.36
70	Lower step, S. W. corner berme abutment, bridge No. 88, marked ⊕		" 10.16	" 140.47
71	Lower step, N. E. corner towpath abutment, bridge No. 90, marked ⊕		" 9.82	" 142.02
72	Lower step, S. E. corner berme abutment, bridge No. 91, marked ⊕		7.93	" 141.83
73	Second step, S. F. corner towpath abutment, bridge No. 92, marked ⊕		" 9.48	" 147.14
74	Lower step, S. W. corner berme abutment, bridge No. 93, marked ⊕		" 9.29	" 141.04
75	Top of masonry, N. side towpath abutment, bridge No. 94, marked ⊕		" 15.60	" 142.12
76	Lower step, S. W. corner berme abutment, bridge No. 95, marked ⊕		" 8.50	" 142.66
77	Lower step, N. corner berme abutment, bridge No. 96, marked ⊕		" 9.58	" 141.47
78	Second step, N. corner berme abutment, bridge No. 97, marked ⊕		" 10.12	" 141.76
79	Lower step, inner corner N. side east abutment, bridge No. 98, marked ⊕		" 8.93	" 149.39
80	Lower step, N. side, towpath abutment, bridge No. 98, marked ⊕	{ lower level	" 9.22	" 132.54
81	Coping, lock No. 15, S. E. gate anchor	{ upper level	" 16.85	" 138.42
82	Lower miter-sill, lock No. 15		" 8.59	" 150.67
83	Upper miter-sill, lock No. 15		0.00	" 153.76
84	Lower step, S. W. corner towpath abutment, bridge No. 100, marked ⊕		-1.38	" 149.42
85	First step, N. E. corner berme abutment, bridge No. 101, marked ⊕		+ 9.87	" 138.47
86	Coping, S. W. gate anchor, lock No. 16	{ lower level	" 12.96	" 132.52
87	Upper miter-sill, lock No. 16	{ upper level	" 16.90	
88	Lower miter-sill, lock No. 16		" 8.62	
			-1.33	
			0.00	

LIST OF BENCH MARKS ON CHAMPLAIN CANAL—(Concluded).

No.	LOCATION AND DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
87	Coping, N. E. gate anchor, lock No. 17.....	{ lower level +16.95	+141.35
88	Lower miter-sill, lock No. 17.....	{ upper level " 8.83	" 124.40
89	Coping, N. E. gate anchor, lock No. 18.....	{ lower level " 16.10	" 133.40
90	Lower miter-sill, lock No. 18.....	{ upper level " 9.00	" 117.30
91	Coping, N. W. gate anchor, lock No. 19	{ lower level " 12.50	" 127.69
92	Lower miter-sill, lock No. 19.....	{ upper level " 10.39	" 115.19
93	Coping, lock No. 20, N. W. gate anchor.....	{ lower level " 13.00	" 125.05
94	Lower miter-sill, lock No. 20.....	{ upper level " 12.86	" 118.05
95	Fourth course from top N. end berme abutment, bridge No. 124, marked ⊕	0.00	" 128.20
96	Fifth course from top S. E. corner S. end berme abutment, bridge No. 126, marked ⊕	" 13.15	" 126.67
97	Sixth course from top S. E. corner S. end berme abutment, bridge No. 127, marked ⊕	" 11.62	" 126.13
98	Seventh course from top N. W. corner N. end towpath abutment, bridge No. 128, marked ⊕	" 11.08	" 125.37
99	Sixth course from top N. W. corner N. end towpath abutment, bridge No. 130, marked ⊕	" 10.32	" 127.39
100	Eighth course from top N. W. corner N. end towpath abutment, bridge No. 131, marked ⊕	" 12.34	" 124.29
101	Fourth course from top N. E. corner N. end berme abutment, bridge No. 132, marked ⊕	" 9.22	" 126.40
102	Fifth course from top S. E. corner S. end berme abutment, bridge No. 133, marked ⊕	" 11.35	" 125.40
103	Seventh course from top N. W. corner N. end towpath abutment, bridge No. 135, marked ⊕	" 10.35	" 124.21
104	N. end of wing N. W. corner lower course towpath abutment, railroad bridge, marked ⊕	" 9.16	" 123.95
105	Sixth course from top N. W. corner N. end towpath abutment, bridge No. 137, marked ⊕	" 8.90	" 125.21
106	S. end towpath abutment S. W. corner lowest course D. & H. iron railroad bridge	" 10.16	" 125.71
107	Seventh course from top N. W. corner N. end towpath abutment, bridge No. 148, marked ⊕	" 10.66	" 126.11
108	Coping lock No. 21, N. E. gate anchor	" 11.06	" 122.65
		upper level " 7.60	

NOTE.—For summit level between locks 15 and 16 canal bottom is taken as 140.8 + T. W.

LIST OF BENCH MARKS ON GLENS FALLS FEEDER.

No.	LOCATION AND DESCRIPTION.	Elevation above B. C. Old datum.	Elevation above T. W.
1	Lower miter-sill, lock No. 1.....	Cham. canal + 1.3	+142.11
2	Coping N. E. gate anchor lock No. 1.....	{ lower level " 15.82	" 157.93
3	Lower miter-sill, lock No. 2.....	{ upper level " 5.7	" 152.23
4	Coping N. E. gate anchor, lock No. 2.....	0.0	" 168.09
5	Lower miter-sill, lock No. 3.....	{ lower level " 15.86	" 162.28
6	Coping N. E. gate anchor, lock No. 3.....	{ upper level " 5.81	" 178.28
7	Lower miter-sill, lock No. 4.....	0.0	" 173.09
8	Coping N. E. gate anchor, lock No. 4.....	{ lower level " 16.00	" 188.47
9	Lower miter-sill, lock No. 5.....	{ upper level " 5.19	" 183.12
10	Coping N. E. gate anchor, lock No. 5.....	0.0	" 198.64
11	Lower miter-sill, lock No. 6.....	{ lower level " 15.38	" 193.51
12	Coping N. E. gate anchor, lock No. 6.....	{ upper level " 5.35	" 208.83
13	Lower miter-sill, lock No. 7.....	0.0	" 203.54
14	Coping N. E. gate anchor, lock No. 7.....	{ lower level " 15.32	" 218.92
15	Lower miter-sill, lock No. 8.....	{ upper level " 5.29	" 213.85
16	Coping N. E. gate anchor, lock No. 8.....	0.0	" 229.12
17	Lower miter-sill, lock No. 9.....	{ lower level " 15.83	" 223.60
18	Coping N. E. gate anchor, lock No. 9.....	{ upper level " 5.07	" 239.09
19	Lower miter-sill, lock No. 10.....	0.0	" 233.48
20	Coping N. E. gate anchor, lock No. 10.....	{ lower level " 15.49	" 249.00
21	Lower miter-sill, lock No. 11.....	{ upper level " 5.61	" 243.92

LIST OF BENCH MARKS ON GLENS FALLS FEEDER—(Concluded).

No.	DESCRIPTION.	Elevation above C. B. Old datum.	Elevation above T. W.
22	Coping N. E. gate anchor, lock No. 11.....	lower level +16.96	+260.88
23	Lower miter-sill, lock No. 12.....	upper level " 6.86	" 254.02
24	Coping N. E. gate anchor, lock No. 12.....	lower level " 15.87	" 269.89
25	Lower miter-sill, lock No. 13.....	upper level " 5.16	" 264.73
26	Coping N. E. gate anchor, lock 13.....	lower level " 15.55	" 280.28
27	Top of breast-wall, lock No. 13.....	upper level " 5.18	" 273.70
28	Lower step, towpath abutment, bridge No. 3, marked ⊕.....	-1.40	" 285.16
29	Second step, S. E. corner north abutment, bridge No. 4, marked ⊕.....	+10.06	" 287.27
30	Second step, N. W. corner south abutment, bridge No. 4, marked ⊕.....	" 12.17	" 285.24
31	Second step, S. W. corner towpath abutment, bridge No. 5, marked ⊕.....	" 10.14	" 283.01
32	On west end towpath abutment, bridge No. 6, marked ⊕.....	7.91	" 284.13
33	On west end towpath abutment, bridge No. 7, marked ⊕.....	" 9.03	" 285.33
34	On west end towpath abutment, bridge No. 8, marked ⊕.....	" 10.23	" 285.19
35	On wing wall, near east end berme abutment, bridge No. 9, marked ⊕.....	" 10.09	" 285.84
36	Second step, east end berme abutment, D. & H. R. R. bridge, marked ⊕.....	" 10.74	" 284.44
37	On west end towpath abutment, bridge No. 10, marked ⊕.....	" 9.34	" 284.77
38	Top of stone foundation of trestle, west end, in rear of Finch & Pruyn's office, in Glens Falls, marked ⊕.....	" 9.67	" 284.81
39	On east end towpath abutment, bridge No. 11, marked ⊕.....	" 9.71	" 287.43
40	On projecting stone at west end towpath abutment, Morgan's bridge, (first west of bridge No. 11), marked ⊕.....	" 12.33	" 288.50
41	On east end of towpath abutment, abandoned bridge, first east of bridge No. 12, marked ⊕.....	" 13.40	" 282.52
42	Lower step, W. end towpath abutment, bridge No. 12, marked ⊕.....	" 7.42	" 284.33
43	Lower miter-sill, lock No. 14.....	" 9.23	" 275.10
	Coping lock No. 14, north wall, east end, marked ⊕.....	0.0	" 285.73
	Water-surface at foot of lock No. 14.....	" 10.63	" 281.01
		" 5.91	

REPORT
OF THE
DIVISION ENGINEER
OF THE
MIDDLE DIVISION

For the Year Ending September 30, 1898.

Middle Division.

DIVISION ENGINEER'S OFFICE,

SYRACUSE, N. Y., *September 30, 1898.*

HON. CAMPBELL W. ADAMS, *State Engineer and Surveyor, Albany, N. Y.:*

Dear Sir.—I have the honor to herewith hand you my annual report as Division Engineer of the Middle Division, New York State canals, for the fiscal year ending September 30, 1898.

The work done the past year under the supervision of this Department exceeds by several times the amount performed during any previous year upon the canals.

The large number of men constituting the several parties were required to be appointed from the civil service eligible list without regard to fitness from experience in actual construction. The division and resident engineers have been greatly embarrassed from this lack of experience, and the results have not always been entirely satisfactory.

ORDINARY REPAIRS.

As required by law under direction of the Superintendent of Public Works, this Department has performed the duties of furnishing plans and bills of material for structures to be built or rebuilt and attended to repairs of breaks in the canal, to wit: On the opening of navigation, a break occurred at the Greenway Malt House in the city of Syracuse. In consequence of lowering the bottom of the prism upon this level two feet, water found its way under the old vertical wall into the cellar of the malt house which was lower than the canal bottom, and carried away about 80 feet of berme bank and wall. The wall was rebuilt and all necessary repairs made in three days.

The vertical wall between Franklin street and Amos Mills spillway should have been rebuilt instead of being underpinned under

the improvement of contract No. 2, but as the wall appeared upon its face to be in fair condition, no provision was made for a new wall in the estimates for contract No. 2, and as it stood to be underpinned in the usual manner, it was thought to be safe when the level was filled.

As soon as the level became filled, it was discovered that many cellars within five hundred feet of the canal were flooded from percolation of water through the gravel in the bottom of the canal. Especially was this the case at the new Onondaga County Savings Bank building at the corner of Water and South Salina streets, the cellar of which is some twelve feet below canal bottom. It was feared that the foundation to this building might settle, causing great damage to the property.

After careful study of the situation, the Superintendent of Public Works decided to again draw off the level and cover the gravel bottom of canal (which had already been lined with six inches of clay, puddled, in the most porous places) from the weigh lock to Franklin street with a carpet of burlaps, and on top of the same a course of clay puddle from six to eight inches in thickness. This was done with perfect success, so that when the level was filled, no leak was discovered in any cellar. This work was prosecuted day and night and was completed in five days, making a delay to navigation of eight days for repairing wall and stopping leaks in canal bottom.

On May 23d last, an extensive break occurred in the towing path bank on Forestport feeder near the location of the break of last year. The repair of this break was done by the Superintendent of Public Works in the shortest possible time, and navigation was suspended upon the Black River canal twenty-one days.

The cause of this break is not positively known, but is believed to have been started by some evil disposed person, and when once a water course was opened across the bank, the flow of water would speedily do the rest in a bank of sand some seventy feet in height. This bank, as was the one of last year, was repaired in the most thorough manner by inserting a core ten feet

in width of excellent lining material, well puddled for the entire length of the break, with each side protected by triple lap sheeting of two inch spruce plank.

No other break has occurred upon this division during the year, yet many leaks have developed in consequence of the removal of slit and reduction of canal bottom under the improvement contracts, which were detected in time and heroic measures taken to protect the banks, generally by driving triple lap sheet piling through the banks. This has been found to be effectual in all cases at a moderate cost.

EXTRAORDINARY REPAIRS.

The work done under special acts of the legislature under the supervision of this Department is as follows:

CONTRACTS COMPLETED AND SETTLED.

Protecting Cayuga and Seneca Canal at Geneva.

Act, chapter 142, Laws of 1895.

Contract dated, August 6, 1895. E. H. Fleming & Co., contractors.

Engineer's estimate	\$15,000 00
Payments to September 30, 1897.....	\$9,979 00
Payments during this fiscal year.....	2,010 55
	<hr/>
Final account	11,989 55
Appropriation	15,000 00
	<hr/> <hr/>

A description of this work is contained in my report of last year.

SUPERSTRUCTURE FOR SWING BRIDGE OVER BLACK RIVER CANAL AT GARDEN STREET, ROME, N. Y.

Act, chapter 965, Laws of 1895.

Contract dated April 16, 1896. Havana Bridge Works, contractors.

Engineer's estimate	\$4,000 00
Payments to September 30, 1897.....	\$2,635 00
Payments during this fiscal year.....	1,427 23
	<hr/>
Final account	4,062 23
Appropriation for entire bridge.....	7,000 00
	<hr/> <hr/>

CHANGING AND RECONSTRUCTING GENESEE STREET
BRIDGE AT UTICA, N. Y.

Act, chapter 950, Laws of 1896.

Act, chapter 170, Laws of 1895.

Contract dated July 31, 1896. Havana Bridge Works, contractors.

Engineer's estimate	\$28,637 15
Payment to September 30, 1897.....	\$21,964 00
Payment during this fiscal year.....	6,148 23
	<hr/>
Final account	28,112 23
Appropriation	33,000 00
	<hr/> <hr/>

For a description of this work see my report of last year.

REPAIRS TO BREAKWATER, PIERS, DAM No. 1 AND
GATES, ALSO REMOVING BARS AT OWASCO LAKE
OUTLET.

Act, chapter 799, Laws of 1896.

Contract dated December 8, 1896. John J. Hallock, contractor.

Engineer's estimate	\$8,624 00
Payments to September 30, 1897.....	\$6,137 00
Payments during the present fiscal year.	1,870 47
	<hr/>
Final account	8,007 47
Appropriation	10,000 00
	<hr/> <hr/>

For description of this work see my report for last year.

REBUILDING SOUTH WING OF STATE DAM AT WATER- LOO.

Act, chapter 786, Laws of 1897.

Contract dated October 8, 1897. Geo. W. Barlow, contractor.

Engineer's estimate	\$3,725 00
Final account	3,597 72
Appropriation for this and other work.....	15,000 00

This work consisted of facing with dressed quarry stone and coping the stone dam at Waterloo, N. Y.

IMPROVING CAYUGA AND SENECA CANAL FROM GEN- EVA HARBOR TO OUTLET.

Act, chapter 558, Laws of 1897.

Contract dated September 9, 1897. Buffalo Dredging Co., contractor.

Engineer's estimate	\$9,000 00
Final account	8,959 17
Appropriation	10,000 00

This work consisted of dredging Geneva harbor and prism of canal from the harbor to the outlet of Seneca lake, to furnish seven feet of water.

COMPLETING REPAIRS, ETC., AT OWASCO LAKE OUTLET AND CONSTRUCTING A WALL OF RUBBLE MASONRY AT FOOT OF OWASCO LAKE.

Act, chapter 799, Laws of 1896.

Act, chapter 561, Laws of 1897.

Contract dated September 1, 1897. John J. Hallock contractor.

Engineer's estimate	\$16,509 00
Final account	19,957 46
Appropriation for this and other work.....	28,000 00

This work consists of constructing a substantial sea wall of stone masonry at the foot of Owasco lake, to protect the highway, and raising and strengthening the highway where it had been

washed away, and also for completing the stone pier at the outlet.

CONSTRUCTING A TOWPATH SWING BRIDGE AT HIGGINSVILLE, N. Y.

Act, chapter 566, Laws of 1897.

Contract dated September 30, 1897. Wrought Iron Bridge Co., contractors.

Engineer's estimate	\$3,512 00
Final account	3,489 81

This work consisted of constructing a steel swing bridge on the towpath across the old abandoned Oneida Lake canal, at Higginsville, in place of an old wooden structure which had been condemned.

CONSTRUCTING A PIPE CULVERT UNDER THE CAYUGA AND SENECA CANAL AT MONTEZUMA, N. Y.

Act, chapter 566, Laws of 1897.

Contract dated October 9, 1897. Martin & Barlow, contractors.

Engineer's estimate	\$5,400 00
Final account	3,912 58

This work consisted of constructing a pipe culvert across the Cayuga and Seneca canal below lock No. 11, at Montezuma, to take place of a condemned composite culvert which had failed and caused a break.

REBUILDING LOCK No. 51, BLACK RIVER CANAL.

Act, chapter 566, Laws of 1897.

Contract dated September 1, 1897. Wilkes D. Dodge, contractor.

Engineer's estimate	\$15,785 00
Payments to September 30, 1897.....	\$12,007 00
Payments during this fiscal year.....	4,130 64
Final account	16,137 64

REBUILDING LOCK No. 55, BLACK RIVER CANAL.

Act, chapter 566, Laws of 1897.

Contract dated September 1, 1897. Wilkes D. Dodge, contractor.

Engineer's estimate	\$15,785 00
Final account	19,281 47

In comparing the estimates for rebuilding locks Nos. 51 and 55, they were each of the same lift and the surrounding conditions were the same in each case, and were estimated to cost equally the same, but on the removal of the old lock to foundation it was found that the foundation of lock No. 51 was perfectly substantial except some replanking, while it was found that lock No. 55 was so badly decayed that a new foundation had to be substituted, which accounts for the additional cost.

REBUILDING EAST PIER OF BELGIUM BRIDGE.

Act, chapter 950, Laws of 1896.

Contract dated December 7, 1896. John J. Hallock, contractor.

Engineer's estimate	\$2,750 00
Payments to September 30, 1897.....	\$2,125 00
Payments during this fiscal year.....	649 61
Final account	2,774 61
Appropriation	3,000 00

For description of this work see my report of last year.

CONSTRUCTING A BRIDGE AT FIRST AND ONEIDA STREETS, IN THE VILLAGE OF FULTON.

Act, chapter 113, Laws of 1897.

Contract dated October 11, 1897. Rochester Bridge and Iron Works, contractors.

Engineer's estimate	\$28,215 00
Final account	24,860 86
Appropriation	30,000 00

This work consists of constructing a steel bridge over the Oswego canal, at Fulton, in place of two Whipple truss cast-iron bridges, condemned, including the repairs in masonry and brick paving on bridge and approaches.

CONSTRUCTING A STEEL BULKHEAD AT WATERLOO DAM.

Act, chapter 786, Laws of 1897.

Contract dated February 28, 1898. Havana Bridge Works, contractors.

Engineer's estimate	\$1,611 00
Final account	1,145 17

This work consisted of placing a steel structure in place of the wooden one that had become so badly decayed that it was unsafe.

WORK IN FORCE, NOT COMPLETED.

LIFT BRIDGE OVER THE ERIE CANAL AT SALINA STREET, SYRACUSE, N. Y.

Act, chapter 571, Laws of 1897.

Contract dated February 24, 1898. Groton Bridge and Manufacturing Co., contractors.

Engineer's estimate	\$35,425 00
Payments to September 30, 1898.....	23,987 00
Appropriation	36,000 00

LIFT BRIDGE AT WHITESBORO STREET, UTICA.

Act, chapter 563, Laws of 1897.

Contract dated February 24, 1898. Groton Bridge and Manufacturing Co., contractors.

Engineer's estimate	\$25,567 00
Payments to September 30, 1898.....	10,574 00
Appropriation	25,000 00

LIFT BRIDGE AT BROAD STREET, UTICA.

Act, chapter 565, Laws of 1897.

Contract dated February 28, 1898. Havana Bridge Works, contractors.

Engineer's estimate	\$22,816 50
Payments to September 30, 1898.....	11,781 00
Appropriation	25,000 00

These bridges are in the course of construction and will be finished at an early date.

The lift bridge over the Erie canal at West Genesee street, Syracuse, built last season but not used, owing to the porous character of rock in foundation of the culvert, fully explained in my last annual report, was taken in hand by Messrs. Brummelcamp & Lane, contractors, early in the spring.

The plan adopted for cutting away the foundation of concrete and rock between and under the side walls to the depth of two feet for the whole length of the culvert, filling the space to within ten inches of grade with Portland cement concrete, and laying a floor of ten-inch plank on edge, extending nine inches under each side wall, all plank well spiked together. To remove and replace the machinery to allow the work to be done was extremely difficult and slow of accomplishment.

The work was fully completed in time for opening of navigation and has been continued in successful operation throughout the present season. The entire cost of this work was \$2,710.23.

IMPROVEMENT OF THE MIDDLE DIVISION UNDER

Act, chapter 79, Laws of 1895, and chapter 794, Laws of 1896.

The work upon the several contracts has progressed in most cases as fast as circumstances would permit, but the appropriation for the work being nearly exhausted, its suspension was ordered by the Superintendent of Public Works and the State Engineer and Surveyor on or about May 14th, since which time nothing has been done under the laws above referred to.

The condition of the towing path and walls were left in a very unfinished condition, and the Superintendent of Public Works found it necessary to do a large amount of work to put the towing path in safe and satisfactory condition for passage of teams and for protecting the banks from leakage in very many places, which developed after filling the canal for navigation, caused by the removal of silt from the prism during the closed season. Early in the season it was feared that breaks would occur from leaky banks, but by promptly driving a liberal amount of triple lap sheet piling at points of greatest danger, navigation has been uninterrupted.

There remains much work to be done by the engineering department to put the notes and computations for work done under the improvement laws in proper shape for record and final settlement; and it is important that this work be done by the assistants in charge of the work so far as possible. The work under many of the contracts has very largely exceeded the preliminary estimate from causes that could not have been foreseen. The estimates were made upon too conservative lines as appeared as the work progressed, but the work done was necessary to put the canal in proper condition, and the character of the work is much more stable than was done during the enlargement of the Erie and Oswego canals, and if completed upon the plans laid out, the Middle Division will be in excellent condition and the annual repairs will be reduced to a minimum.

While the division engineer regrets that the preliminary estimates have been exceeded to so large an extent on several contracts, he feels sure that without superhuman power all the conditions to be encountered could not have been anticipated and provided for in advance.

LAND DAMAGES.

There have been many surveys and maps made showing land taken temporarily or permanently for the improvement of the Erie and Oswego canals. There yet remains a very large number of cases for which no surveys and maps have been made. To

do this work a special appropriation should be made. The owners of property along the whole line are clamoring for these maps as a basis for filing claims against the State for damages. An early disposition of these claims would be desirable, and the initiatory steps cannot be taken until maps are filed according to law.

TABLES.

The following tables are prepared and submitted according to law:

Table No. 1. Showing expenditures by the division engineer for the fiscal year, giving names of the engineers duly appointed by the State Engineer and Surveyor, time employed, rate of compensation and amount paid to each with the amount of other miscellaneous expenditures for ordinary and extraordinary repairs, as well as for the improvement of the Erie and Oswego canals, under chapter 79, Laws of 1895.

Table No. 2. Exhibits contracts in force at the close of the fiscal year, together with engineer's preliminary estimate of the cost of each piece of work and the amount paid thereon.

Table No. 3. Exhibits contracts completed and settled during the fiscal year, with engineer's estimate and total cost of each contract as returned in final account.

Table No. 4. Exhibits estimates of cost of contracts to complete the Oswego canal, not under contract.

Table No. 5. Exhibits water record of Cayuga and Cross lakes and Seneca river, taken tri-annually since 1884, in pursuance of concurrent resolution of Senate and Assembly passed in 1884.

The division engineer takes this opportunity to thank the State Engineer and Surveyor and his deputy for their uniform kindness, confidence and friendly intercourse during the past five years of official connection.

Respectfully submitted,

W. H. H. GERE,

Division Engineer.

TABLE No. 1.

Statement showing the names, rank and compensation of Engineers employed on the Middle Division of the New York State canals, together with incidental expenses for the fiscal year ending September 30, 1898.

Improvement of the Erie Canal.

(Chapter 43, Laws of 1897.)

N A M E.	Rank. .	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. H. H. Gere.....	Division engineer.....	.....	\$3,000 00 per year.	\$1,621 31	\$318 74	\$1,940 05
George A. Morris	Resident engineer.....	.....	2,400 00 per year.	1,450 48	682 18	2,132 66
A. C. Driscoll.....	First assistant engineer ...	49	6 00 per day..	294 00	101 26	395 26
Reeves Smith	First assistant engineer ...	167	6 00 per day..	1,002 00	392 43	1,394 43
Guy Moulton	First assistant engineer ...	250	6 00 per day..	1,500 00	439 38	1,939 38
Guy Moulton	Assistant engineer.....	3	3 00 per day..	15 00	4 02	19 02
George C. Diehl.....	Assistant engineer.....	294	5 00 per day..	1,470 00	827 76	2,297 76
W. W. Olney.....	Assistant engineer.....	245	5 00 per day..	1,225 00	563 16	1,788 16
Noble E. Whitford	Assistant engineer	226	5 00 per day..	1,130 00	271 66	4,401 66
Wm. N. Taintor.....	Assistant engineer.....	118	5 00 per day..	590 00	180 67	770 67
W. J. Town.....	Assistant engineer	252	5 00 per day..	1,260 00	652 99	1,912 99
M. B. Palmer	Assistant engineer	271	5 00 per day..	1,355 00	399 00	1,754 00
George M. Briggs.....	Assistant engineer.....	267	5 00 per day..	1,335 00	396 48	1,731 48
David R. Lee	Assistant engineer.....	279	5 00 per day..	1,395 00	206 44	1,601 44
C. E. Raynor.....	Assistant engineer.....	289	5 00 per day..	1,445 00	349 35	1,794 35
Wm. B. Landreth.....	Assistant engineer.....	244	5 00 per day..	1,220 00	452 37	1,672 37
Glenn D. Holmes	Assistant engineer.....	291	5 00 per day..	1,455 07	471 05	1,926 05
E. H. Thomes.....	Assistant engineer.....	256	5 00 per day..	1,280 00	422 44	1,702 44
M. W. Brown	Assistant engineer.....	228	5 00 per day..	1,140 00	614 40	1,754 40
Arthur O'Brien	Assistant engineer.....	254	5 00 per day..	1,270 00	408 61	1,678 61
S. J. Stewart	Assistant engineer.....	248	5 00 per day..	1,240 00	1 10	1,241 10
Paul L. Schultze.....	Assistant engineer.....	52	5 00 per day..	260 00	6 70	266 70
Paul L. Schultze.....	Assistant engineer.....	100	4 50 per day..	450 00	18 80	468 80

E. D. Rich.....	Assistant engineer.....	155	4 50 per day..	697 50	.....	697 50
Frank B. Clark.....	Assistant engineer.....	119	4 50 per day..	535 50	.....	535 50
Edwin Styring.....	Leveler	27	4 50 per day..	121 50	38 15	159 65
Paul L. Schultze.....	Leveler	40	4 50 per day..	180 00	.....	180 00
S. J. Steward.....	Leveler	40	4 50 per day..	180 00	2 12	182 12
E. D. Rich.....	Leveler	35	4 50 per day..	157 50	.....	157 50
Noble E. Whitford.....	Leveler	36	4 50 per day..	162 00	44 75	206 75
W. J. Towne.....	Leveler	39	4 50 per day..	175 50	215 34	390 84
E. H. Thomas.....	Leveler	41	4 50 per day..	184 50	45 98	230 48
Arthnr O'Brien.....	Leveler	39	4 50 per day..	175 50	44 74	220 24
W. N. Taintor.....	Leveler	39	4 50 per day..	175 50	29 03	204 53
M. W. Brown.....	Leveler	39	4 50 per day..	175 50	50 60	226 10
M. A. McDermott.....	Leveler	198	4 50 per day..	891 00	.....	891 00
Casper Scholz.....	Leveler	202	4 50 per day..	909 00	.....	909 00
Clark Brown.....	Leveler	64	4 50 per day..	288 00	.....	288 00
C. A. Sullivan.....	Leveler	121	4 50 per day..	544 50	.....	544 50
L. H. Ireland.....	Leveler	192	4 50 per day..	864 00	42 46	906 46
J. O. Shipman.....	Leveler	283	4 50 per day..	1,273 50	364 05	1,637 55
R. J. Marcber.....	Leveler	189	4 50 per day..	850 50	.....	850 50
F. C. Humphrey.....	Leveler	136	4 50 per day..	612 00	14 11	626 11
James Burden.....	Leveler	193	4 50 per day..	868 50	45 85	914 35
William Kelley.....	Leveler	135	4 50 per day..	607 50	.....	607 50
L. W. Hall.....	Leveler	149	4 50 per day..	670 50	.....	670 50
C. A. Young.....	Leveler	122	4 50 per day..	549 00	.....	549 00
James G. Tracy.....	Leveler	175	4 50 per day..	787 50	.....	787 50
R. B. Green.....	Leveler	120	4 50 per day..	540 00	.....	540 00
E. A. Lamb.....	Leveler	205	4 50 per day..	922 50	.....	922 50
S. L. Vossler.....	Leveler	117	4 50 per day..	526 50	.....	526 50
Wm. A. Gere.....	Leveler	264	4 50 per day..	1,188 00	.....	1,188 00
B. E. Failing.....	Leveler	132	4 50 per day..	594 00	.....	594 00
H. J. Coupland.....	Leveler	125	4 50 per day..	562 50	.....	562 50
Eugene C. Olcott.....	Draughtsman	260	4 50 per day..	1,170 00	.....	1,170 00
George Rae.....	Draughtsman	215	3 50 per day..	752 50	.....	752 50
Fred J. Wagner.....	Rodman.....	45	4 50 per day..	202 50	10	202 60
M. S. Smith.....	Rodman.....	107	4 50 per day..	481 50	.....	481 50
M. S. Smith.....	Rodman.....	84	3 50 per day..	294 00	.....	294 00
L. K. Devendorf.....	Rodman.....	202	3 50 per day..	707 00	.....	707 00
B. E. Failing.....	Rodman.....	77	3 50 per day..	269 50	.....	269 50
C. A. Sullivan.....	Rodman.....	70	3 50 per day..	245 00	.....	245 00

TABLE No. 1 — *Improvement of the Erie Canal* — (Continued).

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
R. S. Greenman.....	Rodman.....	22	\$3 50 per day..	\$77 00	.....	\$77 00
F. C. Grant.....	Rodman.....	209	3 50 per day..	731 50	.....	731 50
Carroll Blake.....	Rodman.....	269	3 50 per day..	941 50	.....	941 50
Chas. A. Hunt.....	Rodman.....	120	3 50 per day..	420 00	.....	420 00
L. W. Hall.....	Rodman.....	15	3 50 per day..	52 50	.....	52 50
C. D. Kingsley.....	Rodman.....	20	3 50 per day..	70 00	.....	70 00
W. H. Jenkins.....	Rodman.....	117	3 50 per day..	409 50	.....	409 50
Frank M. Williams.....	Rodman.....	127	3 50 per day..	444 50	.....	444 50
J. I. Gayetty.....	Rodman.....	127	3 50 per day..	444 50	.....	444 50
E. W. Sayles.....	Rodman.....	195	3 50 per day..	682 50	.....	682 50
George Penfield.....	Rodman.....	285	3 50 per day..	997 50	.....	997 50
G. D. Williams.....	Rodman.....	289	3 50 per day..	1,011 50	.....	1,011 50
E. H. Steward.....	Rodman.....	196	3 50 per day..	686 00	.....	686 00
B. S. Fellows.....	Rodman.....	194	3 50 per day..	679 00	.....	679 00
Chas. G. Douw.....	Rodman.....	124	3 50 per day..	434 00	.....	434 00
C. K. Muiroe.....	Chainman.....	203	5 00 per day..	1,015 00	\$143 41	1,158 41
E. J. Berry.....	Chainman.....	246	4 50 per day..	1,107 00	124 93	1,231 93
D. E. Whitford.....	Chainman.....	8	3 00 per day..	40 00	.....	40 00
Howard Crounse.....	Chainman.....	295	3 00 per day..	885 00	28 58	913 58
George H. Thomas.....	Chainman.....	83	3 00 per day..	249 00	.....	249 00
George H. Thomas.....	Chainman.....	140	2 50 per day..	350 00	.....	350 00
Louis Meyer.....	Chainman.....	198	2 50 per day..	495 00	.....	495 00
John Schimmel.....	Chainman.....	135	2 50 per day..	337 50	.....	337 50
H. S. Van Valkenburg.....	Chainman.....	241	2 50 per day..	602 50	.....	602 50
Eugene Ryan.....	Chainman.....	155	2 50 per day..	387 50	.....	387 50
Dennis Sullivan.....	Chainman.....	150	2 50 per day..	375 00	.....	375 00
Charles Kiehm.....	Chainman.....	271	2 50 per day..	677 50	.....	677 50
John Hackett.....	Chainman.....	189	2 50 per day..	472 50	3 68	476 18

B. E. Turnbull.....	Chainman.....	26	2 50 per day..	65 00	.....	65 00
C. Hurlbut.....	Chainman.....	272	3 50 per day..	952 00	.....	952 00
William Rowlands.....	Chainman.....	182	2 50 per day..	455 00	.....	455 00
Wm. H. King.....	Chainman.....	98	2 50 per day..	245 00	.....	245 00
W. K. Roberts.....	Chainman.....	153	2 50 per day..	382 50	.....	382 50
H. C. Mortou.....	Chainman.....	244	2 50 per day..	610 00	.....	610 00
A. W. Gillis.....	Chainman.....	148	2 50 per day..	370 00	.....	370 00
George M. Havrer.....	Chainman.....	200	2 50 per day..	500 00	.....	500 00
Bernard Toner.....	Chainman.....	274	2 50 per day..	685 00	.....	685 00
Matthew O'Connor.....	Chainman.....	60	2 50 per day..	150 00	.....	153 41
Frank A. Jackson.....	Chainman.....	189	2 50 per day..	472 50	.....	472 50
J. J. Stack.....	Chainman.....	115	2 50 per day..	287 50	.....	287 50
W. H. S. Morey.....	Chainman.....	155	2 50 per day..	387 50	.....	387 50
A. A. Munson.....	Chainman.....	135	2 50 per day..	337 50	.....	337 50
Jay Capron.....	Chainman.....	185	5 00 per day..	925 00	.....	925 00
John J. Schmid.....	Chainman.....	203	2 50 per day..	507 50	.....	507 50
W. H. Porter.....	Chainman.....	157	3 50 per day..	549 50	.....	549 50
W. H. Porter.....	Chainman.....	82	2 50 per day..	205 00	.....	205 00
Chas. D. Brand.....	Chainman.....	266	2 50 per day..	665 00	.....	665 00
Frank W. Adams.....	Chainman.....	156	2 50 per day..	390 00	.....	390 00
B. F. Bander.....	Chainman.....	47	4 00 per day..	188 00	.....	188 00
Edmund Adams.....	Chainman.....	121	2 50 per day..	302 50	.....	302 50
John D. Luther.....	Chainman.....	114	2 50 per day..	285 00	.....	285 00
John B. Stobo.....	Chainman.....	113	2 50 per day..	282 50	.....	282 50
John C. Mulvihill, Jr.....	Chainman.....	287	2 50 per day..	717 50	.....	717 50
W. H. O'Brien.....	Chainman.....	152	2 50 per day..	380 00	.....	380 00
E. S. Merritt.....	Chainman.....	248	2 50 per day..	620 00	.....	620 00
F. E. Paddock.....	Chainman.....	196	3 50 per day..	686 00	.....	686 00
F. E. Paddock.....	Chainman.....	89	2 50 per day..	222 50	.....	222 50
E. B. Shufelt.....	Chainman.....	33	2 50 per day..	82 50	.....	82 50
Alfred W. Foster.....	Chainman.....	45	2 50 per day..	112 50	.....	112 50
Le Roy Lewis, Jr.....	Chainman.....	199	2 50 per day..	497 50	.....	497 50

TABLE No. 1—Improvement of the Erie Canal—(Continued).

NAME.	Rank.	Number of days.	Rate of compensation.	Salary	Travel.	Total.
Thomas Howard	Chainman	121	\$2 50 per day..	\$302 50	.....	\$302 50
B. C. Van Buren	Chainman	43	2 50 per day..	107 50	.....	107 50
L. Kavanaugh	Chainman	92	2 50 per day..	230 00	.....	230 00
<i>Incidental expenses.</i>						
Labor					\$16,963 75	
Stationery					1,140 07	
Fuel and light					688 88	
Postage					251 69	
Office rent					1,412 83	
Telephone and telegraph					947 16	
Miscellaneous					6,170 67	
					<u>\$27,575 05</u>	27,575 05
						<u>\$112,724 62</u>

TABLE No. 1—Improvement of the Oswego Canal—(Continued).

(Chapter 43, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. H. H. Gere	Division engineer.....	.....	\$3,000 00 per year.	\$378 69	\$19 30	\$397 99
George A. Morris	Resident engineer .....	.....	2,400 00 per year.	389 52	21 25	410 77
A. C. Driscoll	First assistant engineer.....	2	6 00 per day..	12 00	1 70	13 70
Reeves Smith	First assistant engineer.....	74	6 00 per day..	444 00	153 56	597 56
Reeves Smith	Assistant engineer.....	50	5 00 per day..	250 00	204 47	454 47
F. B. Clark	Assistant engineer.....	35	4 50 per day..	157 50	10 65	168 15
Edwin Styling	Leveler	261	4 50 per day..	1,174 50	93 75	1,268 25
C. E. Hopkins	Leveler	197	4 50 per day..	886 50	275 11	1,161 61
E. C. Clark	Leveler	286	4 50 per day..	1,287 00	237 45	1,524 45
L. W. Hall	Leveler	55	4 50 per day..	247 50	.....	247 50
John K. Lloyd	Draughtsman	185	4 50 per day..	877 50	.....	877 50
L. W. Hall	Rodman.....	60	3 50 per day..	210 00	.....	210 00
C. K. Munroe	Chainman.....	100	5 00 per day..	500 00	28 60	528 60
Howard Crounse	Chainman.....	3	3 00 per day..	9 00	1 24	10 24
E. S. Merritt	Chainman.....	28	2 50 per day..	70 00	.....	70 00
Alfred P. Mead, jr.	Chainman.....	275	2 50 per day..	687 50	.....	687 50
H. C. Morton	Chainman.....	26	2 50 per day..	65 00	.....	65 00
Alfred W. Foster	Chainman.....	150	2 50 per day..	375 00	.....	375 00

TABLE No. 1—Improvement of the Oswego Canal—(Continued).

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
George W. Robinson	Chairman.....	63	\$2 50 per day..	\$157 50	.....	\$157 50
H. K. Burlick	Chairman.....	176	2 50 per day..	440 00	.....	440 00
B. C. Van Buren	Chairman.....	9	2 50 per day..	22 50	.....	22 50
Incidental expenses.						
Labor					\$1,675 25	
Stationery.....					88 92	
Fuel and light.....					107 57	
Postage					24 59	
Office rent.....					264 06	
Telephone and telegraph.....					64 23	
Miscellaneous.....					404 07	
						2,628 69
						\$12,316 98

TABLE No. 1—Ordinary Repairs—Erie Canal—(Continued).

(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. H. H. Gere.....	Division engineer.....	.....	\$3,000 00 per year.	\$700 00	\$30 74	\$730 74
George A. Morris.....	Resident engineer.....	.....	2,400 00 per year.	480 00	74 10	554 10
Reeves Smith.....	First assistant engineer.....	17	6 00 per day..	102 00	47 99	149 99
Paul L. Schultze	Assistant engineer.....	4	5 00 per day..	20 00	3 46	23 46
Fred J. Wagner.....	Rodman.....	5	4 50 per day..	22 50	6 92	29 42
E. J. Berry	Chainman.....	15	4 50 per day..	67 50	34 80	102 30
D. E. Whitford	Chainman.....	28	5 00 per day..	140 00	30 83	170 83
Howard Crounse	Chainman.....	22	3 00 per day..	66 00	.....	66 00
George H. Thomas	Chainman.....	2	3 00 per day..	6 00	6 16	12 16
H. S. Van Valkenburg.....	Chainman.....	26	2 50 per day..	65 00	.....	65 00
Incidental expenses.						
Labor .....	.....	.....	.....	.....	\$86 00	
Stationery .....	.....	.....	.....	.....	147 01	
Fuel and light .....	.....	.....	.....	.....	113 79	
Postage .....	.....	.....	.....	.....	17 00	
Office rent.....	.....	.....	.....	.....	34 50	
Telephone and telegraph.....	.....	.....	.....	.....	100 91	
Miscellaneous.....	.....	.....	.....	.....	2,196 24	
						2,675 45
						\$4,579 45

TABLE No. 1—*Ordinary Repairs—Oswego Canal—(Continued).*
(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. H. H. Gere.....	Division engineer.....	.....	\$3,000 00 per year.	\$100 00	.....	\$100 00
George A. Morris.....	Resident engineer.....	.....	2,400 00 per year.	80 00	\$1 50	81 50
Reeves Smith.....	First assistant engineer....	9	6 00 per day..	54 00	14 14	68 14
C. E. Hopkins.....	Leveler	7	4 50 per day..	31 50	.....	31 50
<i>Incidental expenses.</i>						
Miscellaneous.....	.....	.....	.....	.....	.....	\$281 14
						1 75
						\$282 89

TABLE No. 1.— *Ordinary Repairs—Black River Canal—(Continued).*

(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of Compensation.	Salary.	Travel.	Total.
W. H. H. Gere	Division engineer .....	.....	\$3,000 00 per year.	\$100 00	\$10 20	\$110 20
Reeves Smith.....	First assistant engineer ...	2	6 00 per day..	12 00	5 24	17 24
Fred W. Sarr.....	Leveler	13	4 50 per day..	58 50	.....	15 50
Eugene C. Olcott.....	Draughtsman	15	4 50 per day..	67 50	.....	67 50
D. E. Whitford.....	Chainman	134	5 00 per day..	670 00	.....	670 00
						\$923 44

TABLE No. 1—*Ordinary Repairs—Cayuga and Seneca Canal—(Continued).*
(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. H. H. Gere.....	Division engineer.....	.....	\$3 000 00 per year.	\$100 00	.....	\$100 00
D. E. Whitford.....	Chainman.....	68	5 00 per day..	340 00	\$51 93	391 93
<i>Incidental expenses.</i>						
Miscellaneous.....						\$491 93
						9 55
						\$501 48

TABLE No. 1—Repairs to Owasco Lake Outlet—(Continued).

(Chapter 561, Laws of 1897)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Fred. J. Wagner.....	Rodman.....	32	\$4 50 per day.....	\$144 00	\$20 60	\$164 60
G. W. Robinson	Chainman.....	31	2 50 per day.....	77 50	.....	77 50
Incidental expenses.						
Fuel and light.....					\$3 10	
Postage					50	
Office rent					10 00	
Telephone and telegraph.....					50	
Miscellaneous.....					81	
					13 91	
						\$257 01

TABLE No. 1.

Statement showing the names, rank and compensation of Engineers employed on the Middle Division of the New York State canals, together with incidental expenses for the fiscal year ending September 30, 1898.

Improvement of the Erie Canal.

(Chapter 43, Laws of 1897.)

N A M E.	R a n k . .	N u m b e r o f d a y s .	R a t e o f c o m p e n s a t i o n .	S a l a r y .	T r a v e l .	T o t a l .
W. H. H. Gere.....	Division engineer.....	.....	\$3,000 00 per year.	\$1,621 31	\$318 74	\$1,940 05
George A. Morris	Resident engineer.....	.....	2,400 00 per year.	1,450 48	682 18	2,132 66
A. C. Driscoll.....	First assistant engineer ...	49	6 00 per day..	294 00	101 26	395 26
Reeves Smith	First assistant engineer ...	167	6 00 per day..	1,002 00	392 43	1,394 43
Guy Moulton	First assistant engineer ...	250	6 00 per day..	1,500 00	439 38	1,939 38
Guy Moulton	Assistant engineer.....	3	5 00 per day..	15 00	4 02	19 02
George C. Diehl.....	Assistant engineer.....	294	5 00 per day..	1,470 00	827 76	2,297 76
W. W. Olney.....	Assistant engineer.....	245	5 00 per day..	1,225 00	563 16	1,788 16
Noble E. Whitford	Assistant engineer	226	5 00 per day..	1,130 00	271 66	4,401 66
Wm. N. Taintor.....	Assistant engineer.....	118	5 00 per day..	590 00	180 67	770 67
W. J. Town.....	Assistant engineer	252	5 00 per day..	1,260 00	652 99	1,912 99
M. B. Palmer	Assistant engineer	271	5 00 per day..	1,355 00	399 00	1,754 00
George M. Briggs.....	Assistant engineer.....	267	5 00 per day..	1,335 00	396 48	1,731 48
David R. Lee	Assistant engineer.....	279	5 00 per day..	1,395 00	206 44	1,601 44
C. E. Raynor.....	Assistant engineer.....	289	5 00 per day..	1,445 00	349 35	1,794 35
Wm. B. Landreth.....	Assistant engineer.....	244	5 00 per day..	1,220 00	452 37	1,672 37
Glenn D. Holmes	Assistant engineer.....	291	5 00 per day..	1,455 07	471 05	1,926 05
E. H. Thomes.....	Assistant engineer.....	256	5 00 per day..	1,280 00	422 44	1,702 44
M. W. Brown	Assistant engineer.....	228	5 00 per day..	1,140 00	614 40	1,754 40
Arthur O'Brien	Assistant engineer.....	254	5 00 per day..	1,270 00	408 61	1,678 61
S. J. Stewart	Assistant engineer.....	248	5 00 per day..	1,240 00	1 10	1,241 10
Paul L. Schultze.....	Assistant engineer.....	52	5 00 per day..	260 00	6 70	266 70
Paul L. Schultze.....	Assistant engineer.....	100	4 50 per day..	450 00	18 80	468 80

E. D. Rich.....	Assistant engineer.....	155	4 50 per day..	697 50	.....	697 50
Frank B. Clark.....	Assistant engineer.....	119	4 50 per day..	535 50	.....	535 50
Edwin Styring.....	Leveler	27	4 50 per day..	121 50	38 15	159 65
Paul L. Schnltze.....	Leveler	40	4 50 per day..	180 00	.....	180 00
S. J. Steward.....	Leveler	40	4 50 per day..	180 00	2 12	182 12
E. D. Rich.....	Leveler	35	4 50 per day..	157 50	.....	157 50
Noble E. Whitford.....	Leveler	36	4 50 per day..	162 00	44 75	206 75
W. J. Towne.....	Leveler	39	4 50 per day..	175 50	215 34	390 84
E. H. Thomas.....	Leveler	41	4 50 per day..	184 50	45 98	230 48
Arthur O'Brien.....	Leveler	39	4 50 per day..	175 50	44 74	220 24
W. N. Taintor.....	Leveler	39	4 50 per day..	175 50	29 03	204 53
M. W. Brown.....	Leveler	39	4 50 per day..	175 50	50 60	226 10
M. A. McDermott.....	Leveler	198	4 50 per day..	891 00	.....	891 00
Casper Scholz.....	Leveler	202	4 50 per day..	909 00	.....	909 00
Clark Brown.....	Leveler	64	4 50 per day..	288 00	.....	288 00
C. A. Sullivan.....	Leveler	121	4 50 per day..	544 50	.....	544 50
L. H. Ireland.....	Leveler	192	4 50 per day..	864 00	42 46	906 46
J. O. Shipman.....	Leveler	283	4 50 per day..	1,273 50	364 05	1,637 55
R. J. Marcher.....	Leveler	189	4 50 per day..	850 50	.....	850 50
F. C. Humphrey.....	Leveler	136	4 50 per day..	612 00	14 11	626 11
James Burden.....	Leveler	193	4 50 per day..	868 50	45 85	914 35
William Kelley.....	Leveler	135	4 50 per day..	607 50	.....	607 50
L. W. Hall.....	Leveler	149	4 50 per day..	670 50	.....	670 50
C. A. Young.....	Leveler	122	4 50 per day..	549 00	.....	549 00
James G. Tracy.....	Leveler	175	4 50 per day..	787 50	.....	787 50
R. B. Green.....	Leveler	120	4 50 per day..	540 00	.....	540 00
E. A. Lamb.....	Leveler	205	4 50 per day..	922 50	.....	922 50
S. L. Vossler.....	Leveler	117	4 50 per day..	526 50	.....	526 50
Wm. A. Gere.....	Leveler	264	4 50 per day..	1,188 00	.....	1,188 00
B. E. Failing.....	Leveler	132	4 50 per day..	594 00	.....	594 00
H. J. Coupland.....	Leveler	125	4 50 per day..	562 50	.....	562 50
Eugene C. Olcott.....	Draughtsman	260	4 50 per day..	1,170 00	.....	1,170 00
George Rae.....	Draughtsman	215	3 50 per day..	752 50	.....	752 50
Fred J. Wagner.....	Rodman.....	45	4 50 per day..	202 50	10	202 60
M. S. Smith.....	Rodman.....	107	4 50 per day..	481 50	.....	481 50
M. S. Smith.....	Rodman.....	84	3 50 per day..	294 00	.....	294 00
L. K. Devendorf.....	Rodman.....	202	3 50 per day..	707 00	.....	707 00
B. E. Failing.....	Rodman.....	77	3 50 per day..	269 50	.....	269 50
C. A. Sullivan.....	Rodman.....	70	3 50 per day..	245 00	.....	245 00

TABLE No. 1 — *Improvement of the Erie Canal — (Continued).*

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
R. S. Greenman.....	Rodman.....	22	\$3 50 per day..	\$77 00	.....	\$77 00
F. C. Grant.....	Rodman.....	209	3 50 per day..	731 50	.....	731 50
Carroll Blake.....	Rodman.....	269	3 50 per day..	941 50	.....	941 50
Chas. A. Hunt.....	Rodman.....	120	3 50 per day..	420 00	.....	420 00
L. W. Hall.....	Rodman.....	15	3 50 per day..	52 50	.....	52 50
C. D. Kingsley.....	Rodman.....	20	3 50 per day..	70 00	.....	70 00
W. H. Jenkins.....	Rodman.....	117	3 50 per day..	409 50	.....	409 50
Frank M. Williams.....	Rodman.....	127	3 50 per day..	444 50	.....	444 50
J. I. Gayetty.....	Rodman.....	127	3 50 per day..	444 50	.....	444 50
E. W. Sayles.....	Rodman.....	195	3 50 per day..	682 50	.....	682 50
George Penfield.....	Rodman.....	285	3 50 per day..	997 50	.....	997 50
G. D. Williams.....	Rodman.....	289	3 50 per day..	1,011 50	.....	1,011 50
E. H. Steward.....	Rodman.....	196	3 50 per day..	686 00	.....	686 00
B. S. Fellows.....	Rodman.....	194	3 50 per day..	679 00	.....	679 00
Chas. G. Douw.....	Rodman.....	124	3 50 per day..	434 00	.....	434 00
C. K. Muirroe.....	Chainman.....	203	5 00 per day..	1,015 00	\$143 41	1,158 41
E. J. Berry.....	Chainman.....	246	4 50 per day..	1,107 00	124 93	1,231 93
D. E. Whitford.....	Chainman.....	8	3 00 per day..	40 00	.....	40 00
Howard Crounse.....	Chainman.....	295	3 00 per day..	885 00	28 58	913 58
George H. Thomas.....	Chainman.....	83	3 00 per day..	249 00	.....	249 00
George H. Thomas.....	Chainman.....	140	2 50 per day..	350 00	.....	350 00
Louis Meyer.....	Chainman.....	198	2 50 per day..	495 00	.....	495 00
John Schimmel.....	Chainman.....	135	2 50 per day..	337 50	.....	337 50
H. S. Van Valkenburg.....	Chainman.....	241	2 50 per day..	602 50	.....	602 50
Eugene Ryan.....	Chainman.....	155	2 50 per day..	387 50	.....	387 50
Dennis Sullivan.....	Chainman.....	150	2 50 per day..	375 00	.....	375 00
Charles Kiehm.....	Chainman.....	271	2 50 per day..	677 50	.....	677 50
John Hackett.....	Chainman.....	189	2 50 per day..	472 50	3 68	476 18

B. E. Turnbull.....	Chainman.....	26	2 50 per day..	65 00	.....	65 00
C. Hurlbut.....	Chainman.....	272	3 50 per day..	952 00	.....	952 00
William Rowlands.....	Chainman.....	182	2 50 per day..	455 00	.....	455 00
Wm. H. King.....	Chainman.....	98	2 50 per day..	245 00	.....	245 00
W. K. Roberts.....	Chainman.....	153	2 50 per day..	382 50	.....	382 50
H. C. Morton.....	Chainman.....	244	2 50 per day..	610 00	.....	610 00
A. W. Gillis.....	Chainman.....	148	2 50 per day..	370 00	.....	370 00
George M. Havrer.....	Chainman.....	200	2 50 per day..	500 00	.....	500 00
Bernard Toner.....	Chainman.....	274	2 50 per day..	685 00	.....	685 00
Matthew O'Connor.....	Chainman.....	60	2 50 per day..	150 00	.....	153 41
Frank A. Jackson.....	Chainman.....	189	2 50 per day..	472 50	.....	472 50
J. J. Stack.....	Chainman.....	115	2 50 per day..	287 50	.....	287 50
W. H. S. Morey.....	Chainman.....	155	2 50 per day..	387 50	.....	387 50
A. A. Munson.....	Chainman.....	135	2 50 per day..	337 50	.....	337 50
Jay Capron.....	Chainman.....	185	5 00 per day..	925 00	.....	925 00
John J. Schmid.....	Chainman.....	203	2 50 per day..	507 50	.....	507 50
W. H. Porter.....	Chainman.....	157	3 50 per day..	549 50	.....	549 50
W. H. Porter.....	Chainman.....	82	2 50 per day..	205 00	.....	205 00
Chas. D. Brand.....	Chainman.....	266	2 50 per day..	665 00	.....	665 00
Frank W. Adams.....	Chainman.....	156	2 50 per day..	390 00	.....	390 00
B. F. Bander.....	Chainman.....	47	4 00 per day..	188 00	.....	188 00
Edmund Adams.....	Chainman.....	121	2 50 per day..	302 50	.....	302 50
John D. Luther.....	Chainman.....	114	2 50 per day..	285 00	.....	285 00
John B. Stobo.....	Chainman.....	113	2 50 per day..	282 50	.....	282 50
John C. Mulvibill, Jr.....	Chainman.....	287	2 50 per day..	717 50	.....	717 50
W. H. O'Brien.....	Chainman.....	152	2 50 per day..	380 00	.....	380 00
E. S. Merritt.....	Chainman.....	248	2 50 per day..	620 00	.....	620 00
F. E. Paddock.....	Chainman.....	196	3 50 per day..	686 00	.....	686 00
F. E. Paddock.....	Chainman.....	89	2 50 per day..	222 50	.....	222 50
E. B. Shufelt.....	Chainman.....	33	2 50 per day..	82 50	.....	82 50
Alfred W. Foster.....	Chainman.....	45	2 50 per day..	112 50	.....	112 50
Le Roy Lewis, Jr.....	Chainman.....	199	2 50 per day..	497 50	.....	497 50

TABLE No. 1—Improvement of the Erie Canal—(Continued).

NAME.	Rank.	Number of days.	Rate of compensation.	Salary	Travel.	Total.
Thomas Howard	Chairman	121	\$2 50 per day..	\$302 50	.....	\$302 50
B. C. Van Buren	Chairman	43	2 50 per day..	107 50	.....	107 50
L. Kavanaugh	Chairman	92	2 50 per day..	230 00	.....	230 00
Incidental expenses.						
Labor .....	.....	.....	.....	.....	\$16,963 75	\$85,149 57
Stationery.....	.....	.....	.....	.....	1,140 07	
Fuel and light.....	.....	.....	.....	.....	688 88	
Postage .....	.....	.....	.....	.....	251 69	
Office rent .....	.....	.....	.....	.....	1,412 83	
Telephone and telegraph .....	.....	.....	.....	.....	947 16	
Miscellaneous .....	.....	.....	.....	.....	6,170 67	
					\$27,575 05	27,575 05
						\$112,724 62

TABLE No. 1—*Washington Street Bridge at Utica—(Continued).*

(Chapter 397, Laws of 1898.)

George P. Hilton, plans.....\$300 00

Schuyler Street Bridge at Utica.

(Chapter 427, Laws of 1898.)

George P. Hilton, plans.....\$200 00

TABLE No. 1—*Ordinary Repairs—Oswego Canal—(Continued).*
(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days	Rate of compensation.	Salary.	Travel.	Total.
W. H. H. Gere.....	Division engineer.....	.....	\$3,000 00 per year.	\$100 00	.....	\$100 00
George A. Morris.....	Resident engineer.....	.....	2,400 00 per year.	80 00	\$1 50	81 50
Reeves Smith.....	First assistant engineer....	9	6 00 per day..	54 00	14 14	68 14
C. E. Hopkins.....	Leveler	7	4 50 per day..	31 50	.....	31 50
Incidental expenses.						
Miscellaneous.....						\$281 14
						1 75
						\$282 89

TABLE No. 1.—*Ordinary Repairs—Black River Canal—(Continued).*

(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of Compensation.	Salary.	Travel.	Total.
W. H. H. Gere	Division engineer.....	.....	\$3,000 00 per year.	\$100 00	\$10 20	\$110 20
Reeves Smith.....	First assistant engineer ...	2	6 00 per day..	12 00	5 24	17 24
Fred W. Sarr.....	Leveler	13	4 50 per day..	58 50	.....	15 50
Eugene C. Olcott.....	Draughtsman	15	4 50 per day..	67 50	.....	67 50
D. E. Whitford.....	Chainman.....	134	5 00 per day..	670 00	.....	670 00
						\$923 44

TABLE No. 1—*Ordinary Repairs—Cayuga and Seneca Canal—(Continued).*
(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. H. H. Gere.....	Division engineer.....	.....	\$3 000 00 per year.	\$100 00	.....	\$100 00
D. E. Whitford.....	Chainman.....	68	5 00 per day..	340 00	\$51 93	391 93
<i>Incidental expenses.</i>						
Miscellaneous.....						\$491 93
						9 55
						\$501 48

TABLE No. 1—Repairs to Owasco Lake Outlet—(Continued).

(Chapter 561, Laws of 1897)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Fred. J. Wagner.....	Rodman.....	32	\$4 50 per day.....	\$144 00	\$20 60	\$164 60
G. W. Robinson	Chainman.....	31	2 50 per day.....	77 50	.....	77 50
Incidental expenses.						
Fuel and light.....					\$3 10	
Postage					50	
Office rent					10 00	
Telephone and telegraph.....					50	
Miscellaneous.....					81	
					13 91	
						\$242 10
						\$257 01

TABLE No. 1—*Whitesboro Street Bridge at Utica*—(Continued).
(Chapter 588, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Paul L. Schultze.....	Assistant engineer.....	55	\$5 00 per day.....	\$275 00.	.....	\$275 00
George H. Thomas.....	Chainman.....	10	8 00 per day.....	30 00	.....	30 00
John Schimmel.....	Chainman.....	74	2 50 per day.....	185 00	.....	185 00
<i>Incidental expenses.</i>						
Miscellaneous.....						\$490 00
						603 50
						<u>\$1,093 50</u>

TABLE No. 1 — Broad Street Bridge at Utica—(Continued).

(Chapter 565, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Paul L. Schultze	Assistant engineer.....	61	\$5 00 per day.....	\$305 00	\$28 28	\$333 28
George H. Thomas	Chainman.....	77	3 00 per day.....	231 00	.....	231 00
John Schimmel	Chainman.....	15	2 50 per day.....	37 50	.....	37 50
<i>Incidental expenses.</i>						
Fuel and light .....	.....				\$1 80	
Postage.....	.....				3 00	
Office rent .....	.....				9 50	
Miscellaneous.....	.....				580 05	580 05
						\$1,181 83

TABLE No. 1—Extraordinary Repairs—Middle Division—(Continued).

ERIE CANAL.
(Chapter 566, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Reeves Smith	First assistant engineer.....	2	\$6 00 per day.....	\$12 00	\$3 04	\$15 04
J. O. Shipman.....	Leveler	3	4 50 per day.....	13 50	9 44	22 94
Fred. J. Wagner	Rodman.....	81	4 50 per day.....	364 50	40 91	405 41
Chas. G. Douw.....	Rodman.....	43	3 50 per day.....	150 50	8 20	158 70
G. W. Robinson.....	Chainman.....	16	2 50 per day.....	40 00	3 10	43 10
Incidental expenses.						
Labor					\$122 70	\$645 19
Fuel and light.....					5 87	
Postage.....					1 50	
Office rent					20 00	
Telephone and telegraph.....					75	
Miscellaneous.....					3 00	153 82
Total Erie canal.....						\$799 01
BLACK RIVER CANAL.						
Fred. W. Sarr.....	Leveler	71	\$4 50 per day.....	\$319 50	\$153 09	\$472 59
E. J. Berry.....	Chainman.....	6	4 50 per day.....	27 00	11 90	38 90
D. E. Whitford.....	Chainman.....	11	5 00 per day.....	55 00	40 20	95 20
Howard Crounse.....	Chainman.....	6	3 00 per day.....	18 00	11 90	29 90
						\$636 59

<i>Incidental expenses.</i>	
Fuel and light.....	\$0 90
Postage	1 25
Telephone and telegraph.....	2 30
Miscellaneous	8 00
	<hr/>
	12 45
Total Black River canal.....	<hr/>
	\$649 04
Total Erie and Black River canals.....	<hr/>
	\$1,448 05
	<hr/>

TABLE No. 1—*Salina Street Bridge at Syracuse—(Continued).*

(Chapter 571, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Reeves Smith	First assistant engineer....	2	\$6 00 per day.....	\$12 00	.....	\$12 00
James G. Tracy	Leveler	9	4 50 per day.....	40 50	.....	40 50
Fred J. Wagner.....	Rodman	155	4 50 per day.....	697 50	\$0 30	697 80
E. J. Berry	Chainman.....	6	4 50 per day.....	27 00	.....	27 00
<i>Incidental expenses.</i>						
Labor .....	.....				\$157 50	\$777 30
Stationery .....	.....				60	
Miscellaneous.....	.....				993 97	1,152 07
						\$1,929 37

TABLE No. 1—*Washington Street Bridge at Utica*—(Continued).

(Chapter 397, Laws of 1898.)

George P. Hilton, plans..... \$300 00

Schuyler Street Bridge at Utica.

(Chapter 427, Laws of 1898.)

George P. Hilton, plans..... \$200 00

TABLE No. 1—*Extraordinary Repairs—Erie Canal—(Continued).*

(Chapter 506, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Reeves Smith	First assistant engineer....	14	\$6 00 per day.....	\$84 00	\$39 19	\$123 19
Guy Moulton.....	First assistant engineer.....	40	6 00 per day.....	240 00	21 09	261 09
David R. Lee	Assistant engineer	13	5 00 per day.....	65 00	20	65 20
C. E. Raynor.....	Assistant engineer.....	13	5 00 per day.....	65 00	2 08	67 08
Wm. B. Landreth	Assistant engineer.....	13	5 00 per day.....	65 00	10 40	75 40
Glenn D. Holmes.....	Assistant engineer.....	13	5 00 per day.....	65 00	2 86	67 86
Arthur O'Brien	Assistant engineer.....	42	5 00 per day.....	210 00	19 82	229 82
S. J. Steward	Assistant engineer.....	44	5 00 per day.....	220 00	3 56	223 56
Paul L. Schultze	Assistant engineer.....	6	5 00 per day.....	30 00	7 06	37 06
Edwin Styring	Leveler	53	4 50 per day.....	238 50	15 59	254 09
Fred W. Sarr.....	Leveler	22	4 50 per day.....	99 00	17 39	116 39
Wm. A. Gere.....	Leveler	13	4 50 per day.....	58 50	.....	58 50
E. C. Clark	Leveler	49	4 50 per day.....	220 50	14 91	235 41
Eugene C. Olcott	Draughtsman.....	27	4 50 per day.....	121 50	.....	121 50
George Rae	Draughtsman.....	45	3 50 per day.....	157 50	.....	157 50
George Penfield	Rodman.....	13	3 50 per day.....	45 50	.....	45 50
C. K. Munroe	Chainman.....	61	5 00 per day.....	305 00	28 29	333 29
E. J. Berry	Chainman.....	36	4 50 per day.....	162 00	8 38	170 38
Howard Crounse.....	Chainman.....	22	3 00 per day.....	66 00	98 00	66 98
George H. Thomas	Chainman.....	10	3 00 per day.....	30 00	.....	30 00
B. E. Turnbull.....	Chainman.....	48	2 50 per day.....	120 00	.....	120 00
W. H. Porter.....	Chainman.....	53	3 50 per day.....	185 50	.....	185 50
Charles D. Brand	Chainman.....	13	2 50 per day.....	32 50	.....	32 50
						\$3,077 80

<i>Incidental expenses.</i>	
Labor	\$383 50
Stationery	10
Fuel and light	1 00
Postage	3 92
Office rent	11 00
Telephone and telegraph	10 22
Miscellaneous	12 46
	\$422 20
	\$3,500 00

TABLE No. 1—*Surveys—Account of Attorney-General—(Continued).*
(Chapter 606, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation	Salary.	Travel.	Total.
Guy Moulton.....	First assistant engineer....	2	\$6 00 per day.....	\$12 00	\$2 70	\$14 70
W. W. Olney.....	Assistant engineer.....	2	5 00 per day.....	10 00	1 70	11 70
Noble E. Whitford.....	Assistant engineer.....	2	5 00 per day.....	10 00	4 51	14 51
W. J. Town.....	Assistant engineer.....	3	5 00 per day.....	15 00	10 03	25 03
David R. Lee.....	Assistant engineer.....	16	5 00 per day.....	80 00	.....	80 00
H. C. Humphrey.....	Leveler.....	22	4 50 per day.....	99 00	.....	99 00
E. J. Berry.....	Chainman.....	17	4 50 per day.....	76 50	.....	76 50
W. H. Porter.....	Chainman.....	11	3 50 per day.....	38 50	.....	38 50
<i>Incidental expenses.</i>						
Telephone and telegraph.....						\$359 94
						80
						\$360 74

TABLE No. 1—Bridge over the Oswego Canal at Fulton—(Continued).

(Chapter 113, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
C. E. Hopkins.....	Leveler	96	\$4 50 per day.....	\$432 00	\$10 50	\$442 50
John K. Lloyd	Draughtsman	53	4 50 per day.....	238 50	.....	238 50
H. K. Burdick	Chainman.....	51	2 50 per day.....	127 50	.....	127 50
Incidental expenses.						
Labor .....	.....				\$173 25	
Fuel and light .....	.....				11 35	
Postage .....	.....				1 00	
Miscellaneous .....	.....				205 90	
						391 50
						\$1,200 00

TABLE No. 1—Rebuilding Locks—Black River Canal—(Continued).
(Chapter 666, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Fred W. Sarr.....	Leveler.....	226	\$4 50 per day.....	\$1,017 00	\$377 30	\$1,394 30
Gilbert Young.....	Rodman.....	105	3 50 per day.....	367 50	.....	367 50
L. Kavanagh.....	Chainman.....	178	2 50 per day.....	445 00	26 03	471 03
E. B. Shufelt.....	Chainman.....	119	2 50 per day.....	297 50	.....	297 50
Incidental expenses.						
Stationery .....	.....	.....	.....	.....	\$0 50	.....
Fuel and light.....	.....	.....	.....	.....	15 65	.....
Postage .....	.....	.....	.....	.....	4 50	.....
Telephone and telegraph.....	.....	.....	.....	.....	30	.....
Miscellaneous .....	.....	.....	.....	.....	43 32	64 27
						\$2,530 33
						\$2,594 60

TABLE No. 1—Improving the Cayuga and Seneca Canal at Waterloo—(Continued).

(Chapter 512, Laws of 1895.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
12 Reeves Smith.....	First assistant engineer....	1	\$6 00 per day.....	\$6 00	\$2 54	\$8 54
James G. Tracy	Leveler	22	4 50 per day.....	99 00	29 70	128 70
Chas. G. Douw.....	Rodman.....	8	3 50 per day.....	28 00	1 60	29 60
B. F. Bauder.....	Chainman.....	15	4 00 per day.....	60 00	17 71	77 71
B. C. Van Buren	Chainman.....	8	2 50 per day.....	20 00	5 84	25 84
Incidental expenses.						
Labor .....	.....				\$1 25	
Stationery .....	.....				60	
Postage .....	.....				33	
Fuel and light .....	.....				55	
Miscellaneous.....	.....				5 05	
					7 78	
						\$278 17

TABLE No. 1—*Dredging Cayuga and Seneca Canal at Geneva—(Continued).*

(Chapter 558, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Reeves Smith	First assistant engineer	1	\$6 00 per day	\$6 00	\$3 02	\$9 02
Chas. G. Douw	Rodman	77	3 50 per day	269 50	18 25	287 75
D. E. Whitford	Chainman	27	5 00 per day	135 00	7 74	142 74
B. C. Van Buren	Chainman	63	2 50 per day	157 50	.....	157 50
<i>Incidental expenses.</i>						
Postage .....	.....				\$1 79	
Telephone and telegraph .....	.....				80	
Miscellaneous .....	.....				40	
					2 99	
						\$597 01
						\$600 00

TABLE No. 1—*Repairing Dam at Waterloo*—(Continued).

(Chapter 786, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Fred. J. Wagner.....	Rodman.....	6	\$4 50 per day.....	\$27 00	.....	\$27 00
Chas. G. Douw.....	Rodman.....	19	3 50 per day.....	66 50	\$4 70	71 20
D. E. Whitford.....	Chainman.....	8	5 00 per day.....	40 00	13 40	53 40
B. C. Van Buren.....	Chainman.....	27	2 50 per day.....	67 50	.....	67 50
<i>Incidental expenses.</i>						
Postage.....					\$0 50	
Miscellaneous.....					40	
						90
						\$220 00

TABLE No. 1—Ditch Between Seneca Falls and Waterloo—(Continued).

(Chapter 788, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Reeves Smith.....	First assistant engineer.....	9	\$6 00 per day.....	\$54 00	\$16 44	\$70 44
E. C. Clark.....	Leveler	4	4 50 per day.....	18 00	8 66	26 66
Fred J. Wagner.....	Rodman.....	3	4 50 per day.....	13 50	8 38	21 88
E. J. Berry	Chainman.....	4	4 50 per day.....	18 00	9 19	27 19
D. E. Whitford.....	Chainman.....	10	5 00 per day.....	50 00	17 09	67 09
Howard Crounse.....	Chainman.....	4	3 00 per day.....	12 00	7 42	19 42
Incidental expenses.						
Fuel and light.....					\$0 25	
Miscellaneous					2 25	
						2 50
						\$235 18

TABLE No. 1—Removal of Bars in Cayuga and Seneca Canal at Cayuga—(Continued).

(Chapter 606, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Reeves Smith.....	First assistant engineer....	1	\$6 00 per day.....	\$6 00	\$1 98	\$7 98
Eugene C. Olcott.....	Draughtsman	4	4 50 per day.....	18 00	.....	18 00
Fred J Wagner.....	Rodman.....	2	4 50 per day.....	9 00	6 08	15 08
E. J. Berry	Chainman.....	4	4 50 per day.....	18 00	10 08	28 08
D. E. Whitford.....	Chainman.....	20	5 00 per day.....	100 00	8 39	108 39
Howard Crounse.....	Chainman.....	6	3 00 per day.....	18 00	6 08	24 08
Incidental expenses.						
Telephone and telegraph					\$0 25	
Miscellaneous.....					25	
						50
						\$201 61
						\$202 11

TABLE No. 1—Improvement of Public Highways—(Continued).
(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. Roberts.....	Deputy State engineer.....	.....	.....	.....	\$8 67	\$8 67
Reeves Smith	First assistant engineer	16	\$6 00 per day.....	\$96 00	11 10	107 10
Guy Moulton.....	First assistant engineer	19	6 00 per day.....	114 00	50 37	164 37
Arthur O'Brien.....	Assistant engineer	11	5 00 per day.....	55 00	.....	55 00
S. J. Steward.....	Assistant engineer	9	5 00 per day.....	45 00	.....	45 00
Paul L. Schultze	Assistant engineer	16	5 00 per day.....	80 00	31 66	111 66
Fred W. Sarr	Leveler	6	4 50 per day.....	27 00	.....	27 00
Eugene C. Olcott	Draughtsman	7	4 50 per day.....	31 50	.....	31 50
George Rae	Rodman.....	8	3 50 per day.....	28 00	.....	28 00
Fred J. Wagner.....	Rodman.....	2	4 50 per day.....	9 00	.....	9 00
E. J. Berry	Chainman.....	16	4 50 per day.....	72 00	4 35	76 35
Howard Crounse.....	Chainman.....	3	3 00 per day.....	9 00	.....	9 00
Geo. H. Thomas.....	Chainman.....	12	3 00 per day.....	36 00	.....	36 00
H. S. Van Valkenburg	Chainman.....	27	2 50 per day.....	67 50	.....	67 50
B. E. Turnbull.....	Chainman.....	5	2 50 per day.....	12 50	.....	12 50
J. W. Cronin.....	Livery .....	.....	.....	.....	17 00	17 00
						\$805 65
Incidental expenses.						
Labor.....	.....	.....	.....	.....	\$65 13	
Stationery .....	.....	.....	.....	.....	10 40	
Postage.....	.....	.....	.....	.....	1 00	
Telephone and telegraph .....	.....	.....	.....	.....	28	
Miscellaneous .....	.....	.....	.....	.....	10 10	
						\$86 91
						\$892 56

SUMMARY OF TABLE No. 1.
Ordinary Repairs.

ITEMS.	AUTHORIZED BY		Amount.	Total.
	Chapter.	Laws.		
Erie canal.....	435	1897	\$4,579 45	\$6,287 26
Oswego canal.....	435	1897	282 89	
Black River canal.....	435	1897	923 44	
Cayuga and Seneca canal.....	435	1897	501 48	
<i>Extraordinary Repairs.</i>				
<i>Erie Canal.</i>				
Repairs to (1) wasco lake outlet.....	561	1897	\$257 01	10,270 50
Whitesboro street bridge, at Utica.....	563	1897	1,093 50	
Broad street bridge, at Utica.....	565	1897	1,181 83	
Extraordinary repairs, Middle Division.....	566	1897	1,448 05	
Salina street bridge, at Syracuse.....	571	1897	1,929 37	
Washington street bridge, at Utica.....	397	1898	300 00	
Schuyler street bridge, at Utica.....	427	1898	200 00	
Extraordinary repairs, Erie canal.....	506	1898	3,500 00	
Surveys, account of Attorney-General.....	606	1898	360 74	
<i>Oswego Canal.</i>				
Bridge over the Oswego canal at Fulton.....	113	1897	\$1,200 00	1,200 00
<i>Black River Canal.</i>				
Rebuilding locks, Black River canal.....	566	1897	\$2,594 60	2,594 60

SUMMARY OF TABLE No. 1—(Concluded).
Extraordinary Repairs.

ITEMS.	AUTHORIZED BY		Amount.	Total.
	Chapter.	Laws		
<i>Cayuga and Seneca Canal.</i>				
Improving Cayuga and Seneca canal at Waterloo.....	512	1895	\$278 17	
Dredging Cayuga and Seneca canal at Geneva.....	558	1897	600 00	
Repairing dam at Waterloo.....	786	1897	220 00	
Ditch between Seneca Falls and Waterloo.....	786	1897	235 18	
Removal of bars in Cayuga and Seneca canal at Cayuga.....	606	1898	202 11	\$1,535 46
<i>Miscellaneous.</i>				
Improvement of public highways.....	115	1898	\$892 56	892 56
Improvement of the Erie canal.....	43	1897	\$112,724 62	
Improvement of the Oswego canal.....	43	1897	12,316 98	125,041 60
Total abstracts rendered during fiscal year.....	.....	.....	.....	\$147,821 98

TABLE No. 2—EXTRAORDINARY REPAIRS.
Statement of Contracts in Force October 1, 1898.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	LEGISLATIVE ACT.		Engineer's estimate.	Engineer's estimate at contract prices.	Payment to Sept. 30, 1898.
			Chap	Laws.			
Groton Bridge and Mfg. Co.	Feb. 24, 1898	Lift bridge at Salina street, Syracuse, N. Y.	571	1897	*\$35,425 00	\$28,031 50	\$23,987 00
Groton Bridge and Mfg. Co.	Feb. 24, 1898	Lift bridge at Whitesboro street, Utica, N. Y.	563	1897	†25,567 00	18,804 50	10,574 00
Havana Bridge Works.....	Feb. 28, 1898	Lift bridge at Broad street, Utica, N. Y.	565	1897	‡22,816 50	18,480 36	11,781 00
Total. ....	.....	.....	.....	.....	.....	.....	\$46,342 00

* The city of Syracuse pays \$18,600 for Salina street bridge; this includes substructure and superstructure.
† The city of Utica pays \$10,000 for Whitesboro street bridge; this includes substructure and superstructure.
‡ The city of Utica pays \$5,000 for Broad street bridge; this includes substructure and superstructure.

TABLE No. 2—(Continued).
Statement of contracts in force, October 1, 1898.
Improvement of the Erie canal.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	Engineer's preliminary estimate.	Engineer's estimate of contract prices.	Total amount of work done.	Payment to Sept. 30, 1898.	Cost to complete at contract prices.
McDonald & Sayre.....	Nov. 17, 1896	Contract No. 2	\$239,772 00	\$148,948 80	\$300,304 49	\$269,469 00	.....
John Dumfee & Co.....	Nov 14, 1896	Contract No. 3	142,798 00	136,842 00	234,339 27	215,136 00	.....
John Dumfee & Co.....	Nov. 14, 1896	Contract No. 4	155,409 00	154,741 00	606,850 00	546,165 00	.....
John Dumfee & Co.....	Nov. 14, 1896	Contract No. 5	150,614 50	151,618 00	242,403 76	217,350 00	.....
O'Brien & Hoolihan	Mch. 19, 1897	Contract No. 18	96,373 00	91,794 50	208,340 00	187,506 00	\$85,000 00
O'Brien & Hoolihan	Mch. 19, 1897	Contract No. 19	106,322 50	105,053 50	202,630 00	182,367 00	140,000 00
Warren Scharff Asphalt Paving Co....	Aug. 17, 1897	Contract No. 20	246,653 00	242,757 55	76,600 00	68,940 00	270,000 00
Warren Scharff Asphalt Paving Co....	Aug. 17, 1897	Contract No. 21	218,247 00	212,945 45	59,440 00	53,496 00	250,000 00
National Constructing Co.....	Aug. 6, 1897	Contract No. 22	247,465 00	232,307 50	189,210 00	170,289 00	190,000 00
E. H. Gaynor.....	Aug. 23, 1897	Contract No. 23	165,897 00	147,582 00	149,610 00	134,649 00	80,000 00
National Constructing Co.....	Aug. 6, 1897	Contract No. 24	142,051 00	136,720 00	112,340 00	101,106 00	101,000 00
National Constructing Co.....	Aug. 6, 1897	Contract No. 25	140,680 00	127,750 00	109,940 00	98,946 00	155,000 00
John Dumfee & Co.....	Aug. 5, 1897	Contract No. 26	145,452 00	136,600 00	267,600 00	240,840 00	50,000 00
Willoughby B. Priddy.....	Aug. 18, 1897	Contract No. 27	125,869 00	115,713 00	222,740 00	200,466 00	50,000 00
Andrew Onderdonk.....	Aug. 19, 1897	Contract No. 28	172,430 00	167,216 00	129,670 00	116,703 00	100,000 00
Rochester Bridge and Iron Works	Nov. 13, 1897	Contract No. 47	12,425 00	13,289 25	15,735 28	12,654 00	.....
Totals.....	.....	.....	.....	.....	\$3,127,752 80	\$2,816,082 00	\$1,471,000 00

TABLE No. 2—(Concluded).
Statement of Contracts in Force October 1, 1898.
Improvement of the Oswego Canal.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	Engineer's preliminary estimate.	Total amount of work done.	Payment to Sept. 30, 1898.	Cost to complete at contract prices.
Dodge & McGregor	Dec. 8, 1896	Contract No. 6	\$14,497	14,620 00	\$13,158 00	\$1,000 00
John Kelly & Co.	Nov. 16, 1896	Contract No. 7	12,618	5,700 00	5,130 00	6,000 00
John Kelly & Co.	Nov. 16, 1896	Contract No. 8	15,333	9,990 00	8,991 00	5,500 00
John Kelly & Co.	Nov. 16, 1896	Contract No. 9	20,049	15,740 00	14,166 00	5,500 00
Hughes Bros. & Bangs	Nov. 20, 1896	Contract No. 10	48,658	47,420 00	42,678 00	11,000 00
Kirk, Driscoll & Co.	Dec. 20, 1897	Contract No. 34	136,885	79,460 00	71,514 00	100,000 00
Willard Johnson	Aug. 11, 1897	Contract No. 37	13,836	12,053 18	10,773 00	.....
Walter Bradley	Dec. 27, 1897	Contract No. 46	16,860	780 00	702 00	12,000 00
Totals .....	.....	.....	\$278,136 00	\$280,171 50	\$167,112 00	\$141,000 00

TABLE No. 3—EXTRAORDINARY REPAIRS.
Statement of Contracts Completed and Settled During the Year.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	LEGISLATIVE ACT.		Appropriation.	Engineer's estimate.	Amount of final account.
			Chap.	Year.			
E. H. Flemming & Co. Havana Bridge Wks.	Aug. 6, 1895 April 16, 1896	Protecting Cayuga and Seneca canal at Geneva..... Superstructure for swing bridge over Black river canal at Garden street, Rome	142	1895	\$15,000	\$15,000 00	\$11,989 55
Havana Bridge Wks.	July 31, 1896	Changing and reconstructing Genesee street bridge, Utica	965 { 170 950	1895 1896	*7,000 { 33,000	4,000 00 28,637 15	4,062 23 28,112 23
John J. Hallock.....	Dec. 8, 1896	Repairs to breakwaters, piers, dam No. 1 and gates, also removing bars at Owaseo lake outlet.....	799	1896	10,000	8,624 00	8,007 47
George W. Barlow....	Oct. 8, 1897	Rebuilding south wing of State dam at Waterloo..	786	1897	†15,000	3,725 00	3,597 72
Buffalo Dredging Co.	Sept. 9, 1897	Improving Cayuga and Seneca canal from Geneva harbor to outlet	558	1897	10,000	9,000 00	8,959 17
John J. Hallock.....	Sept. 1, 1897	Completing repairs, etc., at Owaseo lake outlet, and constructing a wall of rubble masonry at foot of Owaseo lake	{ 799 561	1896 1897	10,000 18,000	{ 16,509 00 19,957 46	
Wrought Iron Bridge Co.....	Sept. 30, 1897	Constructing a towpath swing bridge at Higginsville, N. Y.	566	1897	.....	3,512 00	3,489 81
Martin & Barlow....	Oct. 9, 1897	Constructing a pipe culvert under C. and S. canal at Montezuma.....	566	1897	.....	5,400 00	3,912 58
Wilkes D. Dodge	Sept. 1, 1897	Rebuilding lock No. 51, Black river canal.....	566	1897	.....	15,785 00	16,137 64
Wilkes D. Dodge	Sept. 1, 1897	Rebuilding lock No. 55, Black river canal	566	1897	.....	15,785 00	19,281 47
John J. Hallock.....	Dec. 7, 1896	Rebuilding east pier of Belgium bridge.....	950	1896	†3,000	2,750 00	2,774 61
Rochester Bridge and Iron Wks.....	Oct. 11, 1897	Constructing bridge at First and Oneida streets in village of Fulton.....	113	1897	30,000	28,215 00	24,860 86
Havana Bridge Wks.	Feb. 28, 1898	Constructing a steel bulkhead at Waterloo dam....	786	1897	†15,000	1,611 00	1,145 17
Total .....	.....	.....	.....	.....	.....	.....	\$156,287 97

* The city of Rome paid \$3,500 for Garden street bridge; this includes substructure and superstructure.
† The towns of Lyons and Clay paid \$1,500 as their share.
‡ This amount includes construction of State ditch between Waterloo and Seneca Falls.

TABLE No. 3—(Continued).
Statement of Contracts Completed and Settled During the Year 1898.
Improvement of the Erie Canal.

NAME OF CONTRACTOR.	Date of contract.	Character of work.	Engineer's preliminary estimate.	Amount of final account.
T. J. Dwyer & Co.	Nov. 19, 1896	Contract No. 1	\$208,420 00	\$301,155 15
Hughes Bros. & Bangs.....	Nov. 20, 1896	Contract No. 13	16,193 50	16,985 15
Total .....	.....	.....	.....	\$318,140 30
<i>Improvement of the Oswego Canal</i>				
Walter Bradley	Nov. 16, 1886	Contract No. 15	66,144 00	\$85,130 96
Edwin Lodder.....	Sept. 30, 1897	Contract No. 36	51,057 00	55,324 38
Total .....	.....	.....	.....	\$140,455 34

TABLE No. 4.
Approximate Estimate of Cost of the Several Contracts Required to Complete the Improvement of the Oswego Canal Not Under Contract.

Contracts.	Amounts.
Contract No. 29.....	\$102,870
Contract No. 30.....	257,590
Contract No. 31, lowering foundation lock No. 3.....	50,000
Contract No. 32.....	309,580
Contract No. 33, lowering foundation guard lock No. 1.....	20,000
Contract No. 35.....	15,000
Contract No. 38.....	165,290
Contract No. 39, lengthening lock No. 13.....	30,000
Contract No. 40.....	134,765
Contract No. 41, lengthening lock No. 14.....	30,000
Contract No. 42, lengthening lock No. 15.....	30,000
Contract No. 43, lengthening lock No. 16.....	30,000
Contract No. 44, lengthening guard lock No. 5.....	20,000
Contract No. 45, lowering foundation lock No. 17.....	30,000
	<hr/>
	\$1,225,095

SUMMARY.

Showing Estimate of Cost of Improvement of the Middle Division, New York State Canals.

Erie Canal.		
Amount of contracts Nos. 12, 14 and 17, settled in 1897.....		\$46,020 64
Amount of contracts settled in 1898 (see table)		318,140 30
Amount of work done (see table "Contracts in Force")		3,127,752 80
Amount of work to be done (see table).....		1,471,000 00
Total cost.....		<u>\$4,962,913 74</u>
Deduct payments to September 1, 1898 (see table)	\$2,816,082 00	
Deduct finals paid in 1897.....	46,020 64	
Deduct finals paid in 1898 (see table).....	<u>318,140 30</u>	
		3,180,242 94
Amount required to complete Erie canal.....		<u><u>\$1,782,670 80</u></u>
Oswego Canal.		
Amount of contracts Nos. 11 and 16, settled in 1897.....		\$132,257 43
Amount of contracts settled in 1898 (see table)		140,455 34
Amount of work done (see table "Contracts in Force")		185,763 16
Amount of work to be done (see table).....		141,000 00
Total cost.....		<u>\$599,475 93</u>
Deduct payments to September 1, 1898 (see table)	\$167,112 00	
Deduct finals paid in 1897	132,257 43	
Deduct finals paid in 1898 (see table).....	<u>140,455 34</u>	
		439,824 77
Amount required to complete present contracts.....		<u>\$159,651 16</u>
Add cost of several contracts not under contract (see table)		1,225,095 00
Amount required to complete Oswego canal.....		<u>\$1,384,746 16</u>
Add amount required to complete Erie canal		1,782,670 80
Total required to complete Middle Division.....		<u><u>\$3,167,416 96</u></u>

REPORT
OF THE
DIVISION ENGINEER
OF THE
WESTERN DIVISION

For the Year Ending September 30, 1898.

Western Division.

ROCHESTER, N. Y., *October 1, 1898.*

HON. CAMPBELL W. ADAMS, *State Engineer and Surveyor:*

Sir.—I have the honor of submitting to you my report on the Western Division of the State canals for the fiscal year ending September 30, 1898.

The canal, slips and navigable feeders are as follows:

	Miles.
Erie canal from the east line of Wayne county to the westerly line of Main street, in the city of Buffalo....	147.88
Clark and Skinner canal, Ohio Basin slip, Commercial slip, and slips Nos. 1, 2 and 3, in the city of Buffalo, aggregate length	1.60
Genesee River feeder, in the city of Rochester.....	2.25
Total	151.73

NOTE.—The Main and Hamburg canal, 1.04 miles long, was conveyed to the city of Buffalo under act, chapter 295 of the Laws of 1898.

UNNAVIGABLE FEEDERS.

Tonawanda and Oak Orchard.....	11.55
Genesee Valley canal, from Cuba reservoir to lock No. 87, Rockville	7.65
Genesee Valley canal from Scottsville to Rochester Rapids dam	11.00
Total	30.20

The resources of water supply for the Erie canal are as follows:

1. Lake Erie, at Buffalo.
2. Tonawanda creek, at Pendleton.
3. Tonawanda and Oak Orchard creeks, at Medina.
4. Allen's creek, through the Genesee Valley canal and Genesee River feeder, from Scottsville to Rochester. This water is connected from the Genesee Valley canal by pipe across the Genesee river to the feeder below the Rapids dam and thence into the canal.
5. The Cuba reservoir, in Allegany county, through the Genesee Valley canal and the Genesee river to Rochester, and through the Genesee River feeder in the city of Rochester into the canal. The Tonawanda and Oak Orchard feeder and the Genesee river assist in filling the canal in the spring. The water from Allen's creek, at Scottsville, which is taken into the feeder at Rochester, tends to keep the water in the feeder pure during the summer months.

DAMS.

There are six dams on the Division as follows:

1. One across Tonawanda creek near its mouth. It raises the waters in the creek about four feet above the level of the Niagara river.
2. One across the same creek south of Medina. Its purpose is to turn the waters of the creek into the feeder, and through it into the channel of Oak Orchard creek, and thence into the canal at Medina.
3. One across Allen's creek, in the village of Scottsville, to send the water through the Genesee Valley canal, which is now used as a feeder from Scottsville to Rochester.
4. One across the Genesee river, at Rochester, to turn the water of the stream into the feeder.
5. One across Oil creek, near the village of Cuba, Allegany county, to hold the waters of the creek and form a reservoir. It is composed of earth faced with riprap and slope wall, and is 2,200 feet long and 65 feet in height where it crosses the stream.

6. One across a valley two miles from the last-mentioned one. It has a waste-weir, composed of stone, to serve as an escape for the waters of the creek when the reservoir is full.

LOCKS.

There are twenty-three locks on this division, and all lock down toward tide water.

No.	LOCATION.	Lift in feet.
53	One and one-fourth miles west of Clyde (lengthened).	4.755
54	At Lock Berlin (lengthened).....	7.360
55	In the village of Lyons (lengthened).....	6.251
56	Poorhouse, one and seven-tenths miles west of Lyons (lengthened).....	9.848
57	Lower lock at Lockville, near Newark (not lengthened).....	8.028
58	Middle lock at Lockville, near Newark (not lengthened).....	8.004
59	Upper lock at Lockville, near Newark (not lengthened).....	8.002
60	Eight-tenths of a mile east of Macedon (lengthened).	9.886
61	In the village of Macedon (lengthened).....	6.601
62	Two and one-quarter miles west of Pittsford (lengthened).....	8.807
63	Miller's lock, in the village of Brighton (lengthened).	8.719
64	Sipple's lock, in the village of Brighton (lengthened).	10.108
65	Reservoir lock, in the city of Rochester (lengthened).	10.102
66	First lock, in the city of Rochester (lengthened)....	8.859
67-71	Five combined locks at Lockport (not lengthened).	57.427

One guard lock at Sulphur Springs (deepened). It has one chamber, 110 x 20 feet and two additional head-gates. These gates are closed when a flood occurs in Tonawanda creek; otherwise, they are left open.

One river lock at Tonawanda connecting the Niagara river with the canal. The lift is generally four feet, depending on the height of water in the river.

One double chamber guard and lift lock (lengthened and deepened) at Black Rock (No. 72). It is 112 x 20 feet. The lift, together with the fall in the harbor from the canal below the mean low water in the lake is..... 2.425

Total 175.182

By adding to the above lifts the surface descent on the different levels, we get the total descent on the division:

On Montezuma level.....	.196	
On Twelve-mile level, Nos. 59 to 60.....	.165	
On Seventeen-mile level, Nos. 61 to 62.....	.343	
On Three-mile level, Nos. 62 to 63.....	.063	
On long level, Rochester to Lockport, Nos. 66 to 67	3.165	
On level between Lockport and Black Rock.....	1.239	
		5.171

Total descent going east..... 180.353

There is also one single chamber slip from Black Rock harbor to Niagara river. It is 200 x 36 feet. The lift is usually four feet, depending on the height of water in lake and river. The weigh lock, in the city of Rochester, has not been used as such for some years.

Nearly all the locks on this division, with the exception of the Black Rock and Sulphur Spring guard locks, need repairing; but this work is to be done under the canal improvement in connection with the deepening of the locks, as will be noted later.

STRUCTURES.

On the Western Division, on the line of the Erie canal and its connecting slips, there are 265 bridges, 152 culverts, 4 aqueducts, 21 waste-weirs and 23 locks.

In this portion of the report no mention will be made of any structures rebuilt or repaired under the \$9,000,000 improvement. They will be mentioned under the special report on that subject.

Tables annexed give the location and characteristics of the different structures.

WEST AVENUE BRIDGE, ROCHESTER.

BRIDGES.

Of the 274 bridges over the canal and its slips 225 are owned by the State, 33 by railroads and private corporations and 16 by cities. Of the 225 State bridges 168 are of steel or iron, 20 of wood and iron, 36 of wood and 1 abutments without bridge.

The bridges in the city of Buffalo are especially in poor condition. With the exception of a few that have been built in late years they are all too light for the present traffic. Among these bridges may be mentioned the two bridges at Ferry street, over the canal and harbor, which are too narrow for the amount of traffic. The Genesee street bridge is altogether too light and will some day fail.

The Lake street bridge, over Commercial slip, has recently been supported by piling, one of the abutments having given out.

The Ohio street bridge, across the Clark and Skinner canal, has been removed from its abutments and the street is now closed. The abutments of this bridge failed and the bridge was removed to save it.

The Commercial street bridge, over the Erie canal, is unsafe. The bridge is too light and the abutments unsafe.

One abutment of the Amherst street bridge is sliding.

No money has been available for rebuilding any of these bridges. I would recommend that money should be appropriated as soon as possible for rebuilding at least some of them, or in the near future the State will be liable for large damage claims for accidents that may happen at any time.

Other bridges that should be rebuilt are the West avenue lift bridge, Rochester; the Pine and Chapel street bridges, Lockport, the latter of which fell during last winter.

EXCHANGE STREET LIFT BRIDGE, ROCHESTER.

Acts, chapters 514, Laws of 1895; 572, Laws of 1897; 791, Laws of 1897, and 506, Laws of 1898.

This is the only new bridge erected during the past year. The bridge is believed to be an improvement on any form of lift bridge theretofore built. The bridge has a single fifty-foot roadway and

two ten-foot sidewalks, and when lowered presents the appearance of an ordinary truss bridge, all of the operating machinery being under ground. The bridge is overcounterweighted and is held down by water pressure taken from the city mains. When the water is shut off the counterweights raise the bridge by sinking into pits situated at each end of the bridge. The two counterweight pits, which are lined with steel, are connected by a steel conduit under the canal in which is located the cylinders.

The cost of this bridge ran considerably over the estimate and contract price. This was due principally to the fact that the bridge was of a new type, and as the work progressed a number of changes in form and design had to be made. With the experience now had it is believed that other bridges of this kind can be built at a much less cost. A photograph and sketch of the bridge show its appearance and the location of the pits and machinery. The cost of the bridge can be seen in the table annexed of "Contracts finished."

BRIDGES UNDER CONTRACT.

The Fitzhugh street lift, the Monroe avenue and South Clinton street bridges, at Rochester, and the Hamilton street bridge, at Buffalo, are under contract. The contract prices, estimates, etc., can be seen in the table annexed of "Contracts pending."

BRIDGE PLANS.

Plans are being made or have been made for the following bridges: New Home, Pendleton; Delaware street, Tonawanda; Erie street, Buffalo; South avenue, Brighton, and Main street, Pittsford. It is expected that these bridges will be built during the coming winter.

CULVERTS.

A large number of the culverts are in need of repair. This is due to lack of proper care in the past. On nearly all of the culverts, except those recently built or repaired, the coping on the wing walls and parapet walls has fallen off or pushed out of place by the frost. In many cases the parapets and wing walls are pushed out of plumb. They all need repointing.



NEW EXCHANGE STREET BRIDGE, ROCHESTER.

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During the year culverts Nos. 1 and 2 were rebuilt and culverts Nos. 78 and 94 were repaired.

A contract was let in 1897 for repairing culverts Nos. 1 and 2 and work was started that winter. These culverts are dive culverts and are situated on the Montezuma level, which runs through a swamp. The foundations of the old culverts were found to be in such poor condition that it was impossible to repair them, as was originally intended. Work was abandoned, new plans prepared and the work again started and finished during the winter of 1898. This entire change of plan causes the large increase of the cost over the contract price. Culvert No. 78 was stripped and covered with concrete and the wings and parapets were repointed. Culvert No. 94 was replaced by a 48-inch cast-iron pipe culvert.

There are now under contract the rebuilding of both ends of culverts Nos. 42 and 45, the rebuilding of one end of culvert No. 43 and the replacing of culvert No. 56 by two 48-inch cast-iron pipes.

AQUEDUCTS.

The aqueducts, with the exception of the one at Medina, are in good shape.

The Medina aqueduct leaks badly both through the arch and around and through the wing walls. It should be partially rebuilt and repaired.

WASTE-WEIRS.

The following waste-weirs should be rebuilt or repaired:

Medina, Albion, Brockville, two at Holley and Brockport. They all leak more or less and are in bad repair.

During the year the Lockport waste-weir was repaired and the Middleport and Mabies weirs were rebuilt. The work of these three weirs was started during the winter of 1897. The original plans contemplated, as in the case of culverts Nos. 1 and 2, only the repairing of the structures.

When work was started the masonry in the Middleport and Mabies weirs was found to be in such bad shape that it was necessary to rebuild them.

New plans were made and the work done during the winter of 1898. This change of plan accounts for the increase in the final estimate over the estimate and contract price.

LOCKS.

The locks are all in fair condition. The south wall of lock No. 71 needs rebuilding, as recommended in the 1895 report.

WORK NOT ON THE CANAL.

The tables annexed show the cost and character of all contract work that has been done or is being done. Besides this contract work, several small pieces of work have been done by the forces of the Superintendent of Public Works upon plans furnished by this office.

The outlet of Bear lake was dredged under act, chapter 606, Laws of 1898. Appropriation, \$1,000.

Under act, chapter 607, Laws of 1898, \$2,000 was appropriated for work on the Cuba reservoir. This improvement consisted in straightening, widening and deepening the Cuba reservoir spillway outlet for a distance of 2,200 feet, making the channel 30 feet wide on the bottom and also building a 60-foot span bridge over the same outlet just below the spillway. See photographs for character of work.

The bridge was constructed of wood, at a cost slightly in excess of the probable cost of a steel bridge. The rebuilding of bridges in wood should be discouraged for evident reasons.

INDIAN RESERVATION.

Under act, chapter 606, Laws of 1898, \$600 was appropriated for repairing the road known as the Erie road, on the Cattaraugus Indian reservation, in the town of Brant. This money has been expended in improving the road designated a distance of 1½ miles, thoroughly ditching and turnpiking the entire distance and coating the traveled portion with gravel. (See map.)

Three thousand five hundred dollars was appropriated for repair of highways on the Allegany Indian reservation in the towns of Great Valley, Red House and South Valley, in the county of

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Red House and South Valley, in the county of

Cattaraugus. This money was apportioned according to the evident needs of the three towns as follows:

After deducting 10 per cent. for engineering, South Valley, \$1,500; Red House, \$1,050; Great Valley, \$600. The improvement accomplished with this fund is as follows:

Town of South Valley, $4\frac{1}{2}$ miles, turnpiked and ditched, 3 miles of which have been coated with gravel. Town of Red House, $3\frac{1}{2}$ miles turnpiked and ditched, 2 miles of which is graveled. Town of Great Valley, $2\frac{1}{2}$ miles turnpiked, ditched and coated with gravel. (See map.)

Five hundred dollars was appropriated to repair the highways on the Indian reservation in the township of Salamanca (Alleghany reservation). This money was expended, after deducting 10 per cent. for engineering, for a 14-foot span bridge with 16-foot roadway, resting on steel abutments. (Photograph submitted.) This bridge is $3\frac{1}{2}$ feet higher than the defective wooden bridge it replaced, the necessary backfilling and grading being done from an unexpended balance of \$331.38 from chapter 790 of the Laws of 1897. A portion of this money was also used for general repairs to the road improved in 1897.

In view of the fact that the Indians pay no taxes and that the only money available for road improvement comes from taxes paid by railroads in the reservation, which is inadequate, the appropriation made by the State for such purposes is a wise expenditure and is a benefit to a large number of taxpayers whose interests make it necessary to use the roads crossing the reservations. The amount of work done with the funds has been unusually large, due to local pride on the part of the foremen secured at the different towns benefited by the improvement to excel in the quantity and quality of work. The system is to be encouraged. The type of small steel bridge built in the town of Salamanca is admirably adapted for this class of roads. The substitution of steel for stone abutments in this case saved at least \$500 and answered every purpose. (See photograph.)

It is recommended that the improvement of these roads be continued and especially, on the plea of public safety, that new

bridges be built over the Allegany river at Onoville and over Clear creek, on the Cattaraugus Indian reservation, west of the Thomas Asylum. Both of these bridges are dangerous, as will be clearly seen by the photographs accompanying this report.

One thousand dollars was appropriated for the "construction of a highway and the necessary sluices, on the Tonawanda Indian reservation, in the county of Genesee, at the westerly end of the Judge road, so-called, to and across the Oak Orchard Creek feeder and gates thereof." Inasmuch as the improvement contemplated in this law involves obtaining right of way for the proposed road, and the estimated expense being greatly in excess of the appropriation, it was not considered well to commence this work until the right of way was secured without cost to the State, and additional money appropriated to do the work contemplated.

CANAL IMPROVEMENT.

Act, chapter 79, Laws of 1895; chapter 794, Laws of 1896; chapter 43, Laws of 1897, and chapter 569, Laws of 1897.

Fifteen contracts were let under act, chapter 79, Laws of 1895. Of these contracts Nos. 1 and 4 have been finished. In the report of last year the work contemplated and done under different contracts was fully mentioned, and only such items of work as have since been done in excess of those noted in the last report will here be mentioned.

CONTRACT No. 1.

Dated December 5, 1896, the Donnelly Contracting Co., of Buffalo, N. Y., contractors. Engineer in charge, O. S. Wilson.

Original engineer's estimate.....	\$433,225 00
Contract price	394,955 00
Additional work authorized by Canal Board.....	36,880 62
Final estimate	636,989 87
Excess of final over contract price.....	242,034 87

IMPROVED CHANNEL, CUBA RESERVOIR OUTLET.

(Chap. 607. Laws of 1888.)

IMPROVED CHANNEL, CUBA RESERVOIR OUTLET.

Chap. 607, Laws of 1898.

ALL STEEL BRIDGE OVER SMALL CREEK WEST OF SALAMANCA. ALLEGANY INDIAN RESERVATION.

Built under Chap. 604, Laws of 1888.

This contract embraced that portion of the Erie canal from Ferry street to Commercial slip, and also included slips Nos. 1, 2, 3 and Commercial slip, a total distance of 3.45 miles.

Work was substantially completed March 5, 1898. The difficulties encountered on this contract were quite fully set forth in the annual report for 1897.

Final estimate records show certain quantities that, unless explained, appear excessive, such as between station 145 and 151, in the vicinity of Porter avenue bridge, cross-sections show material excavated from 4 to 8 feet horizontally behind the rear of walls. This was due to the land in the vicinity being of clay and earth deposited on top of the original lake beach. In excavating for the vertical wall the water from Lake Erie percolated through the sand of the old beach, carrying the same from under the overlaying made earth, undermining this made strata, causing it to cave and assume above the sand a fairly regular slope.

This work was very difficult and expensive to the contractor, necessitating the use of pumps every few feet, and attended with great danger to the men employed. The difficulties were finally surmounted, at an expense to the State of somewhat more than the usual amount of excavation, only the material actually excavated being estimated and no allowance being made for extra trouble and cost to the contractor.

Between Maryland and Hudson streets it was decided to underpin 244 feet of the old vertical wall, it appearing on the face in fair order and with its foundation of timber resting on earth only from 12 to 18 inches above rock.

After work was completed in this vicinity and water had been let in the canal for a period of two months, this underpinned wall fell into the canal, the failure being due to original imperfect construction, the wall being only a facing of stone backed by loose stone not bonded to the face. As the use of cofferdams, to enable this work to be pumped dry, would interfere with navigation and be very expensive, it was decided to dredge sufficient to allow the placing of timber cribs filled with stone

to the height of low water, and on top of the cribs build a vertical wall to the normal bank height.

Owing to this excavation being done by a dredge, and two-thirds under water, the material forming the bank took a very flat slope and probably doubled the amount of material that would have to be moved if done dry. As this work came in the zone, let at a dry price, it was so computed, the difference in favor of the contractor being 5 cents per cubic yard. This was consistent with a ruling made on contract No. 2, where the contractor did certain work dry, when the contract was let to be done wet or with a dredge. This resulted in a saving to the State of 15 cents per cubic yard.

In no other instance was there any more than the usual amount of excavation, and especial mention is made of these two cases, inasmuch as the Canal Investigating Commission reported adversely, from a superficial examination of the cross-section sheets and without ascertaining the facts of the case.

CONTRACT No. 2.

Dated November 4, 1896. Buffalo Dredging Co., contractors.
Engineer in charge, E. A. Sommer.

Original engineer's estimate.....	\$287,834 00
Contract price	291,686 25
Additional work done by authority of Canal Board.	161,089 14
Estimate to date, including 10 per cent. retained...	444,210 00
Estimated cost to complete contract.....	120,422 00
Estimated excess over contract price.....	272,945 75

This contract extends from Ferry street, in the city of Buffalo, to McDonald's culvert, in the vicinity of Pendleton, a distance of 22.07 miles.

The general characteristics and the difficulties encountered on this contract were fully set forth in the annual report of 1897.

The plan of securing the slope wall between Black Rock and Tonawanda by driving a continuous row of 6-inch sheet piling 12 feet long was carried out where walls were in fair condition.

UNSAFE BRIDGES OVER CLEAR CREEK, BETWEEN LAWTONS AND IRVING. CATTARAUGUS INDIAN RESERVATION.

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UNSAFE BRIDGE OVER ALLEGANY RIVER AT ONOVILLE. ALLEGANY INDIAN RESERVATION.

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In the vicinity of Grand Island ferry 4,900 feet of slope wall was too poor to protect in that manner, and a concrete slope wall founded on timber sheet piling was laid.

This contract is now practically completed with the exception of 424,000 cubic yards of excavation, the bulk of which is between Black Rock and Tonawanda. Twelve and sixty-nine hundredths miles of this contract is excavated to the adopted grades.

CONTRACT No. 3.

Dated November 7, 1896. Charles F. Parker & Co., contractors. Engineer in charge, W. L. Curtis.

Original engineer's estimate.....	\$312,510 00
Contract price	188,541 75
Additional work authorized by Canal Board.....	16,348 25
Estimated to date, including 10 per cent. retained..	88,057 15
Estimated cost to complete contract at contract prices	339,273 00
Estimated excess over contract price.....	238,788 40

This contract extends from McDonald's culvert in the vicinity of Pendleton to the head of Lockport locks, a distance of 5.83 miles.

The general methods employed by the contractors were fully set forth in the annual report of 1896. Very little work was accomplished the past winter, and consisted of 36,791 cubic yards earth excavation, 2,156 cubic yards rock excavation, 11,900 square feet rock channeling, and 1,132 cubic yards vertical wall in natural cement.

The history of this contract on the part of the contractors has been one of continued inability to cope with the naturally difficult problems of the situation. Though with an apparent desire to do their full duty to the State and to prosecute the work in an expeditious manner backed by a large outlay of capital, they have lacked the experience and tact to provide expedients to overcome obstacles, so necessary to the successful contractor, and their energy has been expended in a blind and

purposeless expenditure of money and was largely barren in practical results.

The inexperience of the contractors was evidenced in their bid which quoted a price of \$1,475 for bailing and draining, 22 cents for earth excavation, 82½ cents for rock excavation and \$2.50 for vertical wall laid dry.

In view of the high lift on all excavated material (generally about forty feet) the lack of storage ground on which to deliver supplies in summer, the notoriously bad roads in winter, the necessity for a dam to withstand a head of sixteen feet of water at the junction of Contracts 2 and 3, the large amount of drainage from adjacent country in the prism of the canal, the difficulty in passing the water so accumulated around the work and of placing plant in position, and the naturally treacherous soil in the earth-cut below the Sulphur Spring guard lock, the prices were inadequate and the difficulties were never properly considered.

Due to the work not being properly prosecuted to insure its completion within a reasonable time, and the continued neglect to provide the proper means to perform the work, it was deemed best to advise the Superintendent of Public Works to abandon this contract, which was formally done March 22, 1897, at which time the Superintendent of Public Works took charge of the contract and placed the prism of the canal in order for navigation.

The resumption of this work will doubtless necessitate a re-letting of the contract, and it is safe to assume that the prices bid will be considerably higher.

In view of the criticism of the Canal Investigating Commission, who state that one of the existing abuses of the canal is the use of the water from the canal at Lockport without adequate compensation, coupled with an additional expense for the improvement and followed by a recommendation that adequate compensation be obtained for the surplus water, it is but fair to state that the report of the State Engineer for 1896, pages 212 to 214, practically made the same recommendation.

The statement of the Commission that the cost of the canal

improvement was increased to provide water for the millers at Lockport is misleading and not warranted by the facts. The primary object of the 13-foot channel in the narrow rock cut above Lockport was to avoid the excessive current and to provide sufficient water at all times for that portion of the canal from Lockport to Montezuma.

It is a fact that there have been times when, due to low water in Tonawanda creek and Lake Erie, coupled with the very slight descent in grade from Black Rock to Lockport, that enough water could not be secured to feed the levels from Montezuma to Lockport. This occurs with the waste gates into Eighteen Mile creek closed.

I am advised by Section Superintendent Frank Seeley that this condition has existed numerous times, and he cites that on the 10th and 11th of July of this year all waste gates had to be closed, and also two or three times in August, 1897.

So far as cutting off the supply of water from the different interests that have developed in the vicinity of Lockport, it appears to me absurd. The time to do this passed twenty years ago. I think the people would condemn the officials who would destroy the industries that the State had built up, even though primarily it might have been due to either neglect or abuse. This whole matter is better solved by providing for the maintenance of these interests and by legislative action, determining the means under which it should be controlled, securing to the State such compensation as the water is worth, and in this way provide the funds to repay a portion of the investment made primarily for the canal interest during extreme drought, but resulting in benefit to the mills the larger portion of the time.

CONTRACT No. 5.

Dated January 23, 1897, Grannis & O'Connor, contractors.
Engineer in charge, H. K. Bishop.

Original engineer's estimate.....	\$227,102 50
Contract price	217,119 50
Additional work authorized by canal board.....	58,174 15

*Estimated to date, including 10 per cent. retained,	\$276,192 27
Estimated cost to complete contract.....	235,029 50
Estimated excess over contract price.....	294,102 27

This contract extends from lock No. 61 to lock No. 62, a distance of 17.16 miles, and comprises what is known as the "Seventeen Mile Level." The amount of work done the past year is as follows:

Ninety-nine thousand one hundred and fifty-eight cubic yards of earth excavation, 17,510 cubic yards of rock excavation, 567 cubic yards of bridge masonry, 7,824 cubic yards of vertical wall in cement, 12,199 cubic yards of slope wall, 409,612 pounds of cast-iron pipe laid in culverts, 5,639 lineal feet of round piles driven and 1,103,059 feet B. M. four inch by eight to ten foot single row sheet piling driven, and 322,154 feet B. M. hemlock used in foundation.

The items of increase in the contract consist of hard-pan and shale, classified as rock, and which were omitted from the original estimate on account of the failure of the assistant engineer, Mr. H. P. Gillette, to turn in his notes in the form prescribed, and the extra work authorized by the Canal Board included the 1,103,059 feet B. M. sheet piling driven at foot of slope walls to prevent walls caving in canal through the Perinton swamp, which is formed of muck, marl and quicksand.

CONTRACT No. 6.

Dated September 23, 1897. Furnaceville Iron Co., contractors.
Engineer in charge, W. L. Curtis.

Original engineer's estimate.....	\$166,090 00
Contract price	165,800 00
Additional work authorized by Canal Board.....	1,021 35
Estimated to date, including 10 per cent. retained.	61,597 69
Estimated cost to complete contract.....	202,886 77
Estimated excess over contract price.....	98,684 46

*Of this amount \$3,008.70 was paid out of moneys appropriated under act, chapter 506, Laws of 1896.

This contract extends from 1,000 feet west of bridge No. 148 to the foot of Lockport locks, a distance of 8.45 miles.

Most of the work performed on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

Eleven thousand three hundred and twenty-six cubic yards of rock excavation, 2,402 cubic yards of vertical wall masonry, 58,745 cubic yards of earth excavation and 415 cubic yards of slope wall.

The extra work authorized by the Canal Board consisted in underpinning Exchange street bridge at Lockport, and replacing a defective tile culvert at Gasport with cast-iron pipe.

CONTRACT No. 7.

Dated September 3, 1897. Baker & Banker, contractors. Engineer in charge, G. O. House.

Original engineer's estimate.....	\$99,725 00
Contract price	98,760 00
*Estimated to date, including 10 per cent. retained.	75,364 75
Estimated cost to complete contract.....	90,589 00
Estimated excess over contract price.....	67,193 75

This contract extends from Shelby Basin bridge No. 142 to 1,000 feet west of bridge No. 148, a distance of 5.87 miles.

Most of the work performed on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

Forty-six thousand two hundred and fifty cubic yards of earth excavation, 9,700 cubic yards of rock excavation, 142,000 feet B. M. hemlock in wall foundation, 3,945 cubic yards natural wall in cement and 5,845 cubic yards slope wall.

The item of slope wall was largely underpinning, and the slope walls over one-half of this contract are protected so that the prism of the canal can be dredged.

* Of this amount \$228.80 was paid out of moneys appropriated under act, chapter 506, Laws of 1893.

CONTRACT No. 8.

Dated September 21, 1897. Williams, McNaughton & Babst, contractors. Engineer in charge, D. D. Waldo.

Original engineer's estimate	\$191,090 00
Contract price	184,095 00
Additional work authorized by Canal Board.....	23,957 10
Estimated to date, including 10 per cent. retained.	82,720 00
Estimated cost to complete contract.....	284,007 25
Estimated excess over contract price.....	182,632 25

This contract extends from 700 feet west of Long's bridge, No. 134, to Shelby Basin bridge, No. 142, a distance of 8.5 miles.

Most of the work performed on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

Thirty-eight thousand eight hundred and eighty-two cubic yards excavation of earth, 20,486 cubic yards excavation of rock, 5,100 cubic yards vertical wall in cement, 4,502 cubic yards of which was done at a reduced rate from contract price by agreement of Canal Board, the original figure of \$6.50 per cubic yard being considered excessive.

It is estimated that there are 74,000 cubic yards of hard-pan on this contract which would come under a rock price according to the terms of the specifications. This was not so rated in the original estimate.

CONTRACT No. 9.

Dated September 23, 1897. The Furnaceville Iron Co., contractors. Engineer in charge, Newton F. Hopkins.

Original engineer's estimate.....	\$114,440 00
Contract price	111,000 00
Additional work authorized by Canal Board.....	18,554 00
*Estimated to date, including 10 per cent. retained.	80,189 14
Estimated cost to complete contract.....	135,134 15
Estimated excess over contract price.....	104,323 29

* Of this amount \$480 was paid out of moneys appropriated under act, chapter 596, Laws of 1896.

This contract extends from Brailey's bridge, No. 125, to 700 feet west of Long's bridge, No. 134, a distance of 6.06 miles.

Most of the work done on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

Sixty-four thousand and forty-one cubic yards earth excavation, 18,554 cubic yards rock excavation, 108,120 feet B. M. hemlock used in wall foundations, 2,916 cubic yards of vertical wall in natural cement and 3,227 cubic yards of slope wall.

The item of extra work authorized by the Canal Board comprised the rock item of 18,554 cubic yards. No rock was shown on this contract, and the presence of large quantities of hardpan too dense to plow rendered a price sufficient to pay for this necessary.

CONTRACT No. 10.

Dated September 23, 1897. The Furnaceville Iron Co., contractors. Engineer in charge, Carl F. Bannister.

Original engineer's estimate.....	\$152,090 00
Contract price	135,500 00
Estimated to date, including 10 per cent. retained.	38,420 00
Estimated cost to complete contract.....	166,757 00
Estimated excess over contract price.....	69,677 00

This contract extends from 1,000 feet east of Holley bridge No. 115, to Brailey's bridge, No. 125, a distance of 8.44 miles.

Most of the work on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

Forty-three thousand four hundred and twenty-nine yards earth excavation, 13,445 cubic yards rock excavation, 45,426 feet B. M. hemlock in wall foundations, 279 cubic yards vertical wall in cement and 2,597 cubic yards slope wall.

CONTRACT No. 11.

Dated September 23, 1897. The Furnaceville Iron Co., contractors. Engineer in charge, Charles H. Flanigan.

Original engineer's estimate.....	\$116,385 00
Contract price	110,100 00
Additional work authorized by canal board.....	1,128 50
*Estimated to date, including ten per cent. retained.	57,558 68
Estimated cost to complete contract.....	106,475 76
Estimated excess over contract price.....	53,934 44

This contract extends from Cooley's basin bridge No. 106 to 1,000 feet east of Holley bridge No. 115, a distance of 6.63 miles.

Most of the work performed on this contract was done during the fiscal year covered by this report and consisted mainly of the following items:

Thirty-seven thousand six hundred and one cubic yards earth excavation, 14,400 cubic yards of rock excavation, 100,500 feet B. M. hemlock in wall foundations, 2,070 cubic yards vertical wall in cement, 1,760 cubic yards slope wall and 76,700 feet B. M. white oak triple lap sheet piling.

The item of \$1,128.50 for extra work authorized by Canal Board is compensation for driving the built-up triple lap sheet piling.

CONTRACT No. 12.

Dated September 23, 1897. The Furnaceville Iron Co., contractors. Engineer in charge, Charles H. Flanigan.

Original engineer's estimate.....	\$96,540 00
Contract price	87,000 00
Estimate to date, including 10 per cent. retained..	31,310 00
Estimated cost to complete contract.....	122,889 78
Estimated excess over contract price.....	67,199 78

This contract extends from 600 feet east of Norman's bridge No. 97 to Cooley's basin bridge No. 106, a distance of 6.04 miles.

Most of the work performed on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

* Of this amount \$304 was paid out of moneys appropriated under act, chapter 506, Laws of 1898.

Twenty-two thousand nine hundred cubic yards of earth excavation, 13,000 cubic yards of rock excavation, 19,600 feet B. M. hemlock in wall foundations, 275 cubic yards vertical wall in cement and 1,420 cubic yards of slope wall.

CONTRACT No. 13.

Dated September 18, 1897, Henry C. Allen & Co., contractors. Engineer in charge, George J. Lord.

Original engineer's estimate.....	\$119,727 50
Contract price	105,850 00
Additional work authorized by Canal Board.....	4,348 50
*Estimated to date, including 10 per cent. retained	78,160 07
Estimated cost to complete contract.....	128,087 50
Estimated excess over contract price.....	100,397 57

This contract extends from Rowe street bridge No. 86, Rochester, to 600 feet east of Norman's bridge No. 97, a distance of 8.14 miles.

All of the work performed on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

Seventy-one thousand six hundred cubic yards of earth excavation, 18,500 cubic yards of rock excavation, 32,280 feet B. M. hemlock in wall foundations, 1,722 cubic yards vertical wall in cement and 5,800 cubic yards slope wall.

The item of extra work approved by the Canal Board consisted in laying 1,170 lineal feet of 15-inch vitrified tile so spoil bank could be placed over ditch.

CONTRACT No. 14.

Dated September 20, 1897. Whitmore, Rauber & Vicinus, contractors. Engineer in charge, George E. Greene.

Original engineer's estimate.....	\$169,830 00
Contract price	159,685 00

* Of this amount \$12,734.09 was paid out of moneys appropriated under act, chapter 506, Laws of 1898.

Additional work authorized by Canal Board.....	\$46,290 39
Estimated to date, including 10 per cent. retained.	80,730 00
Estimated cost to complete contract.....	151,318 00
Estimated excess over contract price.....	72,363 00

This contract extends from lock No. 66 to Rowe street bridge, all in the city of Rochester, a distance of 4.38 miles.

All the work performed on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

Thirty-seven thousand five hundred cubic yards earth excavation, 3,850 cubic yards rock excavation, 56,000 feet B. M. hemlock in wall foundations, 7,428 cubic yards vertical wall in cement, 2,390 cubic yards slope wall and 306 cubic yards bridge masonry, 1,700 cubic yards lining.

The item of additional work authorized by Canal Board covered the vertical wall which was laid in Portland cement instead of natural cement as per contract.

CONTRACT No. 15.

Dated September 20, 1897. Whitmore, Rauber & Vicinus, contractors. Engineer in charge, Thomas J. Morrison.

Original engineer's estimate.....	\$90,915 00
Contract price	88,595 00
Additional work authorized by Canal Board.....	14,030 00
*Estimated to date, including 10 per cent. retained.	84,882 60
Estimated cost to complete contract.....	72,596 17
Estimated excess over contract price.....	68,883 77

This contract extends from lock No. 62 to lock No. 66, a distance of 4.83 miles.

All the work on this contract was done during the fiscal year covered by this report, and consisted mainly of the following items:

* Of this amount \$720 was paid out of moneys appropriated under act, chapter 506, Laws of 1894.

Eighty-one thousand three hundred and eighty cubic yards earth excavation, 7,800 cubic yards rock excavation, 103,302 feet B. M. hemlock in wall foundations, 2,955 cubic yards vertical wall in cement, 5,097 cubic yards slope wall and 2,440 cubic yards Portland cement concrete.

This item of concrete was approved by the Canal Board and was used to prevent leaks in the canal prism through the village of Brighton and stop claims for damage arising from the water percolating through the banks into the cellars in the vicinity.

In spite of adverse criticism of the press and the investigating committee as to the methods used by this department in estimating and classifying, I believe that every one connected with this division has worked and acted for the interest of the state. Mistakes and errors in judgment may have been made, as will happen in the undertaking of any large work of this kind, but they were mistakes and errors in judgment and nothing else. No one yet ever did any work, whether it involved \$900 or \$9,000,000, but that, had he to do it over again, he would make changes in his first methods.

This division during the year has been in charge of J. L. Little as division engineer, C. R. Neher as resident engineer and M. W. Wilbur as first assistant engineer.

A statement of the engineering expenses of the division is hereto annexed, showing in detail the names of the persons employed, the time of service and compensation of each. Tables showing statistics in regard to contract work and photographs of parts of the work are also annexed.

Respectfully submitted,

J. L. LITTLE,

Division Engineer.

WESTERN DIVISION ERIE CANAL.
Table of Contracts Pending September 30, 1898.

CONTRACTOR.	Contract signed.	Character of Work.	LEGISLATIVE ACT.		Appropriation.	Engineer's estimate.	Contract price.	Estimated to date.
			Chap.	Laws.				
W. A. Gillette.....	Oct. 9, 1897	Improving Cayuga creek.....	559	1897	\$5,000	\$4,380 00	\$2,870 00	\$3,420 00
Rochester Bridge and Iron Wks.	July 8, 1898	Fitzhugh st. lift bridge, Rochester. {	32	1897	20,000	25,969 75	23,931 50	.....
Rochester Bridge and Iron Wks.	Mar. 12, 1898	South Clinton st. bridge, Rochester. {	606	1898	7,000	19,729 50	15,862 00	6,520 00
B. P. Smith.....	Mar. 10, 1898	Monroe ave bridge, Rochester..... {	389	1897	20,000	29,701 65	25,494 00	22,240 00
Buffalo Dredging Co.....	Feb. 24, 1898	Hamilton st. bridge, Buffalo..... {	207	1897	32,000	39,986 10	7,497 00	6,540 00
John Calnan.....	Jan. 10, 1898	Repairing and rebuilding culverts Nos 42, 43, 45 and 56.....	607	1898	4,000	8,055 00	8,860 15	6,280 00
			568	1897	10,000	9,127 00		
			566	1897	.....		
		Canal Improvement Work.						
Buffalo Dredging Co.....	Nov. 4, 1896	Contract No. 2.....				287,834 00	291,636 25	444,210 00
Chas. T. Parker & Co.....	Nov. 7, 1896	Contract No. 3.....				312,510 00	188,641 75	88,060 00
Grannis & O'Connor.....	Jan. 23, 1897	Contract No. 5.....				227,102 50	217,119 50	276,192 27
Furnaceville Iron Co.....	Sept. 23, 1897	Contract No. 6.....				166,090 00	165,800 00	61,609 00
Baker & Banker.....	Sept. 8, 1897	Contract No. 7.....				99,725 00	99,760 00	76,140 00
Williams, McNaughton & Baptist	Sept. 21, 1897	Contract No. 8.....	79	1896		191,090 00	184,095 00	82,729 00
Furnaceville Iron Co.....	Sept. 23, 1897	Contract No. 9.....	794	1896	9,000,000	114,440 00	111,000 00	80,190 00
Furnaceville Iron Co.....	Sept. 23, 1897	Contract No. 10.....	48 & 569	1897		152,090 00	185,500 00	38,420 00
Furnaceville Iron Co.....	Sept. 23, 1897	Contract No. 11.....				116,383 00	110,100 00	57,558 68
Furnaceville Iron Co.....	Sept. 23, 1897	Contract No. 12.....				96,540 00	87,000 00	31,310 00
Henry C. Allen & Co.....	Sept. 18, 1897	Contract No. 13.....				119,727 50	105,850 00	78,160 07
Whitmore, Rauber & Vicinus...	Sept. 20, 1897	Contract No. 14.....				169,880 00	158,695 00	80,730 00
Whitmore, Rauber & Vicinus...	Sept. 20, 1897	Contract No. 15.....				90,915 00	88,595 00	84,100 00

WESTERN DIVISION—ERIE CANAL.

Table of Contracts Finished During the Year Ending September 30, 1898.

CONTRACTOR.	Contract signed.	Work finished.	Character of work.	LEGISLATIVE ACT.		Appropriation.	Engineer's estimate.	Contract price.	Final estimate.
				Chapter.	Laws.				
William's, McNaughton & Bapat.....	Sept. 21, 1896	Dec. 18, 1897	Building a culvert for Oak Orchard creek, Medina.....	791	1896	\$5,000 00	\$6,418 73	\$6,167 61	\$6,119 60
John Dempsey.....	Sept. 25, 1897	Jan 14, 1898	Improving Newtown creek.....	790	1897	2,500 00	8,280 00	6,802 00	8,169 12
Warwick & Hookway..	Feb 9, 1897	May 7, 1898	Rebuilding culverts Nos. 1 and 2.....	949	1896	5,000 00	10,666 00	6,791 90	27,215 57
Pulford, Clark & Tidd.	Oct. 1, 1897	July 27, 1898	Building dyke along Chemung river at Elmira.....	791	1897	10,666 00	3,404 00	2,890 00	3,402 83
W. A. Gillette	Sept. 23, 1897	June 11, 1898	Removing dam across Chemung river at Corning.....	790	1897	4,000 00	4,090 00	3,100 00	4,242 51
Chas. A. Gorman.....	Dec. 7, 1896	May 10, 1898	Rebuilding Lockport, Middleport and Mabies waste weir.....	566	1897	5,000 00	3,444 50	3,531 50	12,139 52
Chambers & Casey	Nov. 29, 1897	June 22, 1898	Exchange street lift bridge, Rochester.....	947	1897	25,000 00	41,837 00	35,196 25	46,545 74
Martin & Barlow.....	Jan. 12, 1898	Apr. 18, 1898	Rebuilding and repairing culverts 78 and 94.....	514	1895	25,000 00	4,554 00	4,510 25	5,419 86
Frank J. Le Valley....	Aug. 29, 1896	Sept. 20, 1898	Improving Mud creek.....	*572	1897	15,000 00	11,520 00	8,810 00	13,228 34
Donnelly Contracting Co.	Nov. 5, 1896	.....	Contract No. 1	791	1897	15,000 00	433,225 00	394,955 00	636,989 87
				506	1898	6,545 74			
				566	1897				
				477	1896				
				*552	1898				
				79	1895				

* Reappropriated.

Extraordinary Repairs—Monroe Avenue Bridge, Rochester, N. Y.

(Chapter 207, Laws of 1897, and Chapter 607, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
C. T. Middlebrook, Jr	Assistant engineer.....	36	\$5 00 per day.....	\$180 00	\$11 36	\$191 36
H. D. Alexander	Leveler	7	4 50 per day.....	31 50	.....	31 50
R. T. Webster.	Chainman.....	18	3 50 per day.....	63 00	70	63 70
Lewis G. Fisher.....	Chainman.....	42	2 50 per day.....	105 00	80	105 80
Wm. E. Drake.....	Laborer	32	2 25 per day.....	72 00	.....	72 00
Incidental expenses.						
Rochester Bridge and Iron Works, preparing plans						\$464 36
Stowell and Cunningham, inspection						630 50
Miscellaneous.....						310 25
Telegram.....						3 17
						35
						\$1,408 63

Extraordinary Repairs—Exchange Street Bridge, Rochester, N. Y.

(Chapter 514, Laws of 1895; Chapters 572 and 791, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little	Division engineer.....	1 month	\$3,000 00 per year..	\$250 00	.....	\$250 00
M. W. Wilbur.....	First assistant engineer....	8	6 00 per day..	48 00	.....	48 00
C. T. Middlebrook, Jr.....	Assistant engineer.....	239	5 00 per day..	1,195 00	\$10 35	1,205 35
H. D. Alexander	Leveler.....	1	4 50 per day..	4 50	.....	4 50
E. R. Payne	Leveler	12	4 50 per day..	54 00	.....	54 00
H. G. McKelvey.....	Draftsman	7	4 00 per day..	28 00	.....	28 00
Fred D. Haak.....	Chainman.....	24	5 00 per day..	120 00	.....	120 00
R. T. Webster.....	Chainman	61	3 50 per day..	213 50	.....	213 50
Lewis G. Fisher.....	Chainman.....	118	2 50 per day..	295 00	1 67	296 67
Wm. E. Drake.....	Laborer.....	67	2 25 per day..	150 75	.....	150 75
<i>Incidental expenses.</i>						
Stowell and Cunningham, inspection .....	.....	.....	.....	.....	.....	\$2,370 77
Miscellaneous.....	.....	.....	.....	.....	.....	254 90
Telegraph .....	.....	.....	.....	.....	.....	76 00
						25
						\$2,701 92

Extraordinary repairs—Waste-Weirs at Lockport, Middleport and near Mabies Bridge.
(Chapter 947, Laws of 1896, and Chapter 566, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
D. D. Walde.....	Leveler	13	\$4 50 per day.....	\$58 50	\$21 67	\$80 17
D. D. Waldo.....	Leveler	22	5 00 per day.....	110 00	17 89	127 89
Fred F. Gordon	Leveler	3	4 50 per day.....	13 50	.....	13 50
H. D. Alexander	Leveler	14	4 50 per day.....	63 00	.....	63 00
Irving Hawkins.....	Leveler	102	4 50 per day.....	459 00	22 10	481 10
Irving Hawkins.....	Rodman.....	6	3 50 per day.....	21 00	5 60	26 60
Chas. E. Cleaver	Rodman.....	2	3 50 per day.....	7 00	.....	7 00
H. G. McKelvey.....	Draftsman	18	4 00 per day.....	72 00	.....	72 00
W. F. Stratton.....	Laborer	71	2 25 per day.....	159 75	2 20	161 95
Incidental expenses.						
Telegraph and telephone.....						\$1,083 01
						1 50
						\$1,084 51

Extraordinary Repairs—Deepening and Improving Eighteen-Mile Creek.
(Chapter 609, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little	Division engineer .....	.....	.....	.....	\$11 21	\$11 21
C. R. Neber	Resident engineer .....	.....	.....	.....	11 12	11 12
M. W. Wilbur	First assistant engineer	2	\$6 00 per day	\$12 00	11 12	23 12
W. L. Curtis	Assistant engineer	49	5 00 per day	245 00	29 08	274 08
G. L. Van Dusen	Rodman	36	3 50 per day	126 00	.....	126 00
Jos. W. Howe	Rodman	38	3 50 per day	133 00	.....	133 00
Walter Dubey	Chainman	5	3 50 per day	17 50	6 00	23 50
Dan D. Mead	Chainman	42	2 50 per day	105 00	3 62	108 62
H. G. White	Laborer	45	4 50 per day	202 50	7 24	209 74
Incidental expenses.						
Livery .....	.....	.....	.....	.....	.....	\$920 39
Miscellaneous .....	.....	.....	.....	.....	.....	69 00
Labor .....	.....	.....	.....	.....	.....	67 74
Postage, telegraph and telephone .....	.....	.....	.....	.....	.....	20 00
Stationery .....	.....	.....	.....	.....	.....	5 01
						65
						\$1,082 79

Extraordinary Repairs—Culverts Nos. 78 and 94.

(Chapter 566, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
D. D. Waldo	Leveler	9	\$5 00 per day	\$45 00	\$5 02	\$50 02
H. D. Alexander	Leveler	2	4 50 per day	9 00	.....	9 00
H. G. McKelvey	Draftsman	7	4 00 per day	28 00	.....	28 00
A. W. Peters	Chainman	30	2 50 per day	75 00	.....	75 00
						\$162 02

Extraordinary Repairs—Culverts Nos. 42, 43, 45 and 56.

(Chapter 566, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. B. Barrett	Leveler	20	\$4 50 per day	90 00	.....	\$90 00

Extraordinary Repairs—Bridge over Canal Feeder at Medina.

(Chapter 606, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
D. D. Waldo.....	Leveler	20	\$5 00 per day.....	100 00	11 42	\$111 42
H. G. McKelvey	Draftsman.....	4	4 00 per day.....	16 00	.....	16 00
Incidental expenses.						
Postage, telegraph and telephone						
Miscellaneous.						
						\$127 42
						1 90
						50
						\$129 82

Extraordinary Repairs—Bridge over Oak Orchard Creek Feeder, Medina.
(Chapter 791, Laws of 1896, and Chapter 790, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
D. D. Waldo	Leveler	24	\$4 50 per day	\$108 00	\$27 89	\$135 89
D. D. Waldo	Leveler	12	5 00 per day	60 00	17 72	77 72
Irving Hawkins	Leveler	9	4 50 per day	40 50	.....	40 50
Chas. E. Cleaver	Leveler	9	4 50 per day	40 50	.....	40 50
Chas. E. Cleaver	Rodman	26	3 50 per day	91 00	.....	91 00
H. G. McKelvey	Draftsman	19	4 00 per day	76 00	8 64	84 64
A. W. Peters	Chaumman	10	2 50 per day	25 00	.....	25 00
Incidental expenses.						
Laber						\$495 25
Miscellaneous						\$72 00
						11 20
						\$578 45

Extraordinary Repairs—Erie Street Bridge, Buffalo.
(Chapter 611, Laws of 1898.)

Stowell and Cunningham, preparing plans \$650 00

Extraordinary Repairs—Improving Channel Leading from State Culvert Under Erie Canal at Brockport, N. Y.

(Chapter 947, Laws of 1896, and Chapter 503, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel	Total.
R. T. Webster	Chairman	41	\$3 50 per day	\$143 50	.....	\$143 50
Henry Geck	Chairman	50	2 50 per day	125 00	.....	125 00
<i>Incidental expenses.</i>						
Miscellaneous.....						\$268 50
						3 00
						\$271 50

State Court of Claims.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
F. H. Crafts	Assistant engineer.....	35	\$5 00 per day.....	\$175 00	\$19 97	\$194 97
D. D. Waldo	Leveler	45	5 00 per day.....	225 00	79 59	304 59
Irving Hawkins.....	Leveler	7	4 50 per day.....	31 50	8 23	39 73
Wm. Crennell, Jr.....	Leveler	17	4 50 per day.....	76 50	8 80	85 30
Isaac O. Cole.....	Rodman	53	3 50 per day.....	185 50	15 93	201 43
Ray S. Palmer	Rodman	44	3 50 per day.....	154 00	16 24	170 24
Harty C. Brown.....	Chainman	52	2 50 per day.....	130 00	9 86	139 86
E. V. Allendorph.....	Laborer	54	2 25 per day.....	121 50	12 18	133 68
Incidental expenses.						
Livery.....						\$1,269 80
Postage, telegraph and telephone						175 50
Miscellaneous						6 43
						37 06
						\$1,488 79

Extraordinary Repairs—Culverts Nos. 1 and 2.
(Chapter 947, Laws of 1896, and Chapter 566, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
M. W. Wilbur.....	First assistant engineer.....	2	\$6 00 per day.....	\$12 00	\$9 14	\$21 14
F. H. Crafts	Assistant engineer.....	187	5 00 per day.....	935 00	49 85	984 85
H. D. Alexander	Leveler	17	4 50 per day.....	76 50	.....	76 50
Fred F. Gordon	Leveler	6	4 50 per day.....	27 00	.....	27 00
H. G. McKelvey.....	Draftsman	12	4 00 per day.....	48 00	.....	48 00
A. H. Wilcox	Rodman	98	3 50 per day.....	343 00	3 40	346 40
A. W. Peters.....	Chainman.....	32	2 50 per day.....	77 50	3 83	81 33
L. Williams	Laborer	97	2 25 per day.....	218 25	4 11	222 36
Incidental expenses.						
Livery.....						\$1,807 58
						58 00
						\$1,865 58

Extraordinary Repairs—Fitzhugh Street Bridge, Rochester.

(Chapter 32, Laws of 1897.)

George P. Hilton, preparing plans.....	\$712 50
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Extraordinary Repairs—South Clinton Street Bridge, Rochester, N. Y.

(Chapter 339, Laws of 1897.)

Stowell and Cunningham, preparing plans	\$483 62
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Extraordinary Repairs—Deepening and Improving Cayuga Creek.

(Chapter 559, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Carl L. Lund	Leveler	47	\$4 50' per day	\$211 50	\$9 75	\$221 25
Joseph Kiener	Laborer	41	2 25 per day	92 25	2 95	95 20
						\$316 45

Extraordinary Repairs—Deepening and Improving Mud Creek.

(Chapter 477, Laws of 1896, and Chapter 552, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
W. L. Curtis.....	Assistant engineer.....	9	\$5 00 per day.....	\$45 00	.....	\$45 00
Jos. W. Howe.....	Rodman.....	63	3 50 per day.....	220 50	\$3 62	224 12
G. L. Van Dusen.....	Rodman.....	10	3 50 per day.....	35 00	4 12	39 12
D. D. Mead.....	Chainman.....	9	2 50 per day.....	22 50	3 50	26 00
H. G. McKelvey.....	Draftsman.....	5	4 00 per day.....	20 00	.....	20 00
Incidental expenses.						
Labor.....	.....	.....	.....	.....	.....	\$354 24
Livery.....	.....	.....	.....	.....	.....	44 00
Miscellaneous.....	.....	.....	.....	.....	.....	69 00
						20
						\$467 44

Extraordinary Repairs—Bridge over Allegany River between Carrollton and Allegany.

(Chapter 790, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
M. W. Wilbur.....	First assistant engineer....	4	\$6 00 per day.....	\$24 00	\$38 41	\$62 41

Extraordinary Repairs—Removing Obstructions, Etc., Chemung River at Corning.

(Chapter 790, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
F. H. Crafts.....	Assistant engineer.....	12	\$5 00 per day.....	\$60 00	\$3 68	\$63 68
F. H. Crafts	Leveler	36	4 50 per day.....	162 00	4 00	166 00
E. R. Payne.....	Leveler	17	4 50 per day.....	76 50	20 55	97 05
E. R. Payne.....	Rodman.....	21	3 50 per day.....	73 50	7 00	80 50

Incidental expenses.

Postage, telephone and telegraph.....	\$407 23
Miscellaneous.....	2 59
	1 35
	\$411 17

Extraordinary Repairs—Dredging Bear Lake.
(Chapter 606, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little.....	Division engineer.....	.....	.....	\$25 00	\$17 40	\$42 40
M. W. Wilbur.....	First assistant engineer....	3	\$6 00 per day.....	18 00	12 85	30 85
Incidental expenses.						
Telegraph and telephone.....						\$73 25
						1 60
						\$74 85

Extraordinary Repairs—Protecting Unfinished Work Under General Improvements, etc.

(Chapter 500, Laws of 1898.)

		Rate of compensation.	Salary.	Travel.	Total.
M. W. Wilbur.....	First assistant engineer.....	10	\$60 00	.....	\$60 00
G. O. House	Assistant engineer.....	26	130 00	\$5 68	135 68
H. K. Bishop.....	Leveler	21	105 00	2 00	107 00
Geo. J. Lord	Leveler	27	121 50	7 22	128 72
Thos. J. Morrison	Leveler	7	31 50	.....	31 50
Joa. B. Barrett.....	Leveler	26	117 00	6 56	123 56
F. L. Hurlbut.....	Rodman.....	26	91 00	73	91 73
Tracy B. Smith	Chainman	21	52 50	1 60	54 10
Incidental expenses.					
Livery .....	.....				\$732 29
Office rent .....	.....				60 00
Telegraph and telephone.....	.....				11 00
Miscellaneous .....	.....				1 68
					2 86
					\$807 83

Extraordinary Repairs—Southport Road, Chemung County.
(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. Roberts.....	Deputy State engineer.....	.....	.....	.....	\$20 40	\$20 40

Extraordinary Repairs—Enlarging Spillway Cuba Reservoir.
(Chapter 607, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
C. E. Neher.....	Resident engineer.....	.....	.....	.....	\$25 04	\$25 04
M. W. Wilbur.....	First assistant engineer.....	3	\$8 00 per day.....	\$18 00	20 70	38 70
Thos. J. Morrison	Leveler	2	\$4 50 per day.....	9 00	.....	9 00
						\$72 74

Extraordinary Repairs—Improving Glen Creek, Watkins, N. Y.

(Chapter 624, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little	Division engineer.....	.....	.....	.....	\$4 62	\$4 62
John R. Kaley	First assistant engineer....	5	\$6 00 per day.....	\$30 00	21 48	51 48
Geo. E. Greene.....	Assistant engineer.....	5	5 00 per day.....	25 00	9 59	34 59
Irving Hawkins.....	Leveler	2	4 50 per day.....	9 00	5 02	14 02
Fred F. Gordon	Leveler	2	4 50 per day.....	9 00	.....	9 00
H. G. McKelvey.....	Draftsman	4	4 00 per day.....	16 00	.....	16 00
Avery H. Wilcox.....	Rodman.....	2	3 50 per day.....	7 00	5 52	12 52
Incidental expenses.						
Telephone and telegraph.....						\$142 23
						1 05
						\$143 28

Extraordinary Repairs—Buffalo Hamburg Road, Erie County.

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. Roberts.....	Deputy State engineer.....	.....	.....	.....	\$49 52	\$49 52
J. L. Little	Division engineer.....	.....	.....	\$25 00	53 53	78 53
M. W. Wilbur.....	First assistant engineer.....	3	\$6 00 per day.....	18 00	10 11	28 11
Geo. E. Greene.....	Assistant engineer.....	25	5 00 per day.....	125 00	59 08	184 08
Irving Hawkins.....	Leveler	28	4 50 per day.....	128 00	27 62	155 62
H. D. Alexander	Leveler	4	4 50 per day.....	18 00	.....	18 00
H. G. McKelvey.....	Draftsman	13	4 00 per day.....	52 00	.....	52 00
F. W. Hamilton.....	Rodman.....	8	3 50 per day.....	28 00	6 38	34 38
Avery H. Wilcox.....	Rodman.....	25	3 50 per day.....	87 50	25 13	112 63
Jas. S. Cook	Chainman	16	3 50 per day.....	56 00	25 74	81 74
Walter Dubey.....	Chainman	12	3 50 per day.....	42 00	8 90	50 90
<i>Incidental expenses.</i>						
Livery.....	.....	.....	.....	.....	.....	\$843 51
Telegraph and telephone .....	.....	.....	.....	.....	.....	8 00
Miscellaneous.....	.....	.....	.....	.....	.....	3 12
						2 95
						\$857 58

Extraordinary Repairs—Ridge Road, Monroe County.

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. Roberts.....	Deputy State Engineer .....	.....	.....	.....	\$13 08	\$13 08
M. W. Wilbur.....	First Assistant Engineer...	4	\$6 00 per day.....	\$24 00	4 00	28 00
Geo. E. Greene.....	Assistant engineer.....	20	5 00 per day.....	100 00	3 05	103 05
H. K. Bishop.....	Leveler	6	5 00 per day.....	30 00	.....	30 00
Irving Hawkins.....	Leveler	3	4 50 per day.....	13 50	70	14 20
T. J. Morrison.....	Leveler	26	4 50 per day.....	117 00	2 25	119 25
H. G. McKelvey.....	Draughtsman	8	4 00 per day.....	32 00	.....	32 00
F. W. Hamilton	Rodman.....	21	3 50 per day.....	73 50	3 60	77 10
Avery H. Wilcox.....	Rodman.....	2	3 50 per day.....	7 00	70	7 70
Isaac O. Cole.....	Rodman.....	4	3 50 per day.....	14 00	.....	14 00
Fred D. Haak.....	Chainman.....	4	5 00 per day.....	20 00	.....	20 00
James S. Cook	Chainman.....	17	3 50 per day.....	59 50	3 70	63 20
R. B. McDonald.....	Chainman.....	18	2 50 per day.....	45 00	3 05	48 05
Dan D. Mead.....	Chainman.....	2	2 50 per day.....	5 00	.....	5 00
Tracey B. Smith.....	Chainman.....	2	2 50 per day.....	5 00	.....	5 00
H. G. White	Laborer	7	4 50 per day.....	31 50	1 50	33 00
Incidental expenses.						
Livery						\$612 63
						76 00
						\$688 63

Extraordinary Repairs—East Avenue Road, Monroe County.

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
H. Roberts.....	Deputy State Engineer .....	.....	.....	.....	\$13 08	\$13 08
Geo. E. Greene.....	Assistant engineer	18	\$5 00 per day.....	\$90 00	2 00	92 00
C. T. Middlebrook, Jr.....	Assistant engineer	1	5 00 per day.....	5 00	.....	5 00
Irving Hawkins.....	Leveler	6	4 50 per day.....	27 00	1 97	28 97
Thos. J. Morrison	Leveler	4	4 50 per day.....	18 00	.....	18 00
H. D. Alexander	Leveler	4	4 50 per day.....	18 00	.....	18 00
H. G. McKelvey.....	Draftsman	13	4 00 per day.....	52 00	.....	52 00
Avery H. Wilcox.....	Rodman.....	8	3 50 per day.....	28 00	1 51	29 51
F. W. Hamilton.....	Rodman.....	11	3 50 per day.....	38 50	1 05	39 55
James S. Cook.....	Chainman.....	10	3 50 per day.....	35 00	1 71	36 71
B. B. McDonald.....	Chainman.....	10	2 50 per day.....	25 00	2 22	27 22
<i>Incidental expenses.</i>						
Livery.....	.....	.....	.....	.....	.....	\$360 04
Miscellaneous .....	.....	.....	.....	.....	.....	9 00
.....	.....	.....	.....	.....	.....	40
.....	.....	.....	.....	.....	.....	\$369 44

Extraordinary Repairs—River Road, Erie County.

(Chapter 115, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little	Division engineer.....	.....	.....	.....	\$8 16	\$8 16
W. L. Curtis.....	Assistant engineer.....	10	\$5 00 per day.....	\$50 00	14 87	64 87
Walter Dubey.....	Chainman.....	3	3 50 per day.....	10 50	40	10 90
Dan D. Mead	Chainman.....	3	2 50 per day.....	7 50	9 48	16 98
H. G. White	Laborer.....	3	4 50 per day.....	13 50	10 78	24 28
Incidental expenses.						
Telegraph and telephone.....						\$125 19
Miscellaneous.....						70
						2 10
						\$127 99

Extraordinary Repairs—Improving Newtown Creek.

(Chapter 949, Laws of 1896; Chapter 791, Laws of 1897, and Chapter 607, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
John R. Kaley	First assistant engineer....	6	\$6 00 per day.....	\$36 00	\$59 58	\$95 58
Thos. J. Morrison	Leveler	13	4 50 per day.....	58 50	13 58	72 08
Fred F. Gorden	Leveler	15	4 50 per day.....	67 50	16 83	84 38
F. L. Hurlbut.....	Rodman	7	3 50 per day.....	24 50	3 00	27 50
James S. Cook.....	Chainman.....	7	3 50 per day.....	24 50	12 83	37 33
L. Williams.....	Laborer.....	20	2 25 per day.....	45 00	1 40	46 40
Incidental expenses.						
Postage, telegraph and telephone.....						\$363 22
Miscellaneous						98
						3 75
						\$367 95

Extraordinary Repairs—Dyke along Chemung River, Elmira.

(Chapter 950, Laws of 1896, and Chapter 790, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
John R. Kaley	First Assistant engineer ...	4	\$6 00 per day	\$24 00	\$41 11	\$65 11
H. P. Gillette	Assistant engineer	6	5 00 per day	30 00	.....	30 00
Chas. E. Witcher	Chaiuman.....	29	2 50 per day	72 50	10 10	82 60
F. L. Hurlbut.....	Laborer	26	2 25 per day	58 50	3 65	62 15
L. Williams.....	Laborer	5	2 25 per day	11 25	.....	11 25
						\$251 11

Extraordinary Repairs—Hamilton Street Bridge, Buffalo.

(Chapter 568, Laws of 1897.)

NAME.		Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
E. A. Sommer.....		Leveler	24	\$5 00 per day.....	\$120 00	\$6 60	\$126 60
F. W. Hamilton.....		Rodman	60	3 50 per day.....	210 00	7 00	217 00
Walter Dubey.....		Chainman	30	3 50 per day.....	105 00	2 00	107 00
Incidental expenses.							
Rochester Bridge & Iron Works, preparing plans							
Miscellaneous							
							\$450 60
							75 00
							25
							\$525 85

Extraordinary Repairs—Improving Highway Allegany Indian Reservation.

(Chapter 790, Laws of 1897, and Chapter 606, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
C. B. Neher.....	Resident engineer .....	.....	.....	.....	\$81 76	\$81 76
M. W. Wilbur	First assistant engineer....	4	\$6 00 per day.....	\$24 00	21 96	45 96
Incidental expenses.						
Telegraph and telephone						
						\$127 72
						2 82
						\$130 54

Extraordinary Repairs--Improving Highway Tonawanda Indian Reservation.

(Chapter 606, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little	Division engineer.....	.....	.....	.....	\$10 55.	\$10 55
M. W. Wilbur.....	First assistant engineer....	5	\$6 00 per day.....	\$30 00	8 56	38 56
D. D. Waldo	Leveler	5	5 00 per day.....	25 00	5 64	30 64
Isaac O. Cole.....	Rodman.....	2	3 50 per day.....	7 00	3 64	10 64
Incidental expenses.						
Livery.....						\$90 39
Telegraph and telephone.....						8 00
						1 12
						\$99 51

Extraordinary Repairs—Lift Bridge at Brighton.

(Chapter 618, Laws of 1898.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
Thos. J. Morrison.	Leveler	2	\$4 50 per day.....	\$9 00	.....	\$9 00
H. K. Bishop.....	Leveler	1	5 00 per day.....	5 00	.....	5 00
Tracy B. Smith.....	Chainman.....	1	2 50 per day.....	2 50	.....	2 50
Incidental expenses.						
George P. Hilton, preparing plans.....						\$16 50
						541 85
						\$558 35

Extraordinary Repairs—New Home Bridge.

(Chapter 220, Laws of 1898.)

NAME.	Rank.	Number of days.	Salary.	Travel.	Total.
J. L. Little.....	Division engineer.....	.....	.....	\$3 74	\$8 74
C. R. Neher.....	Resident engineer.....	.....	.....	8 80	8 80
M. W. Wilbur.....	First assistant engineer.....	3	\$18 00	15 44	33 44
E. A. Sommer.....	Leveler.....	1	5 00	4 26	9 26
H. G. McKelvey.....	Draftsman.....	3	12 00	.....	12 00
<i>Incidental expenses.</i>					
Telegraph and telephone.....					\$67 24
					46
					\$67 70

Ordinary Repairs.

(Chapter 435, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little.....	Division engineer.....	.....	\$3,000 00 per year.	\$550 00	\$141 14	\$691 14
C. R. Neher.....	Resident engineer.....	3 mos..	2,400 00 per year.	600 00	5 26	605 26
M. W. Wilbur.....	First assistant engineer...	56	6 00 per day..	336 00	127 81	463 81
John R. Kaley.....	First assistant engineer....	7	6 00 per day..	42 00	31 76	73 76
Geo. E. Greene.....	Assistant engineer.....	23	5 00 per day..	115 00	74 11	189 11
C. T. Middlebrook, Jr.....	Assistant engineer.....	46	5 00 per day..	230 00	13 03.	243 03
H. P. Gillette.....	Assistant engineer.....	101	5 00 per day..	505 00	74 25	579 25
W. L. Curtis.....	Assistant engineer.....	31	5 00 per day..	155 00	19 96	174 96
E. A. Sommer.....	Leveler.....	27	5 00 per day..	135 00	50 96	185 96
D. D. Waldo.....	Leveler.....	22	5 00 per day..	110 00	19 22	129 22
E. R. Payne.....	Leveler.....	72	4 50 per day..	324 00	19 91	343 91
Fred F. Gordon.....	Leveler.....	3	4 50 per day..	13 50	.....	13 50
H. D. Alexander.....	Leveler.....	5	4 50 per day..	22 50	.....	22 50
Thos. J. Morrison.....	Leveler.....	2	4 50 per day..	9 00	.....	9 00
H. G. McKelvey.....	Draftsman.....	25	4 00 per day..	100 00	.....	100 00
Jos. B. Barrett.....	Rodman.....	52	3 50 per day..	182 00	11 51	193 51
Ray Morris.....	Rodman.....	12	3 50 per day..	42 00	14 33	56 33
F. L. Hurlbut.....	Rodman.....	67	3 50 per day..	234 50	1 35	235 85
F. W. Hamilton.....	Rodman.....	14	3 50 per day..	49 00	5 68	54 68
Isaac O. Cole.....	Rodman.....	16	3 50 per day..	56 00	1 40	57 40
Fred D. Haak.....	Chainman.....	48	5 00 per day..	240 00	23 21	263 21
R. T. Webster.....	Chainman.....	28	3 50 per day..	98 00	.....	98 00
Walter Dubey.....	Chainman.....	67	3 50 per day..	234 50	17 80	252 30
Henry Geck.....	Chainman.....	263	2 50 per day..	657 50	.....	657 50
Chas. E. Whitchoer.....	Chainman.....	93	2 50 per day..	232 50	15 89	248 39
Jas. S. Cook.....	Chainman.....	2	2 50 per day..	5 00	8 30	13 30
Dan D. Mead.....	Chainman.....	29	2 50 per day..	72 50	20 30	92 80
Lewis G. Fisher.....	Chainman.....	5	2 50 per day..	12 50	1 36	13 86
E. B. McDonald.....	Chainman.....	12	2 50 per day..	30 00	14 24	44 24
H. G. White.....	Laborer.....	36	4 50 per day..	162 00	33 20	195 20

A. M. Lorscheider.....	Laborer.....	53	2 25 per day..	119 25	119 25
F. L. Hurlbut.....	Laborer.....	40	2 25 per day..	90 00	94 50
L. Williams.....	Laborer.....	40	2 25 per day..	90 00	94 45
F. G. Moses.....	Laborer.....	27	2 25 per day..	60 75	60 75
<i>Incidental expenses.</i>					
Miscellaneous.....					\$6,669 93
Office rent					712 08
Stationery					625 04
Telegraph and telephone.....					157 26
Livery.....					187 12
Postage					88 00
Fuel and light					15 00
Labor					6 12
					13 25
					\$8,473 80

Extraordinary Repairs—Canal Improvement.

(Chapter 79, Laws of 1895; Chapter 794, Laws of 1896; Chapters 43 and 569, Laws of 1897.)

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
J. L. Little	Division engineer.	.....	\$3,000 00 per year.	\$2,150 00	\$996 89	\$3,146 89
C. R. Neher	Resident engineer.	9 mos.	2,400 00 per year.	1,800 00	807 73	2,607 73
M. W. Wilbur	First assistant engineer.	258	6 00 per day..	1,548 00	545 19	2,093 19
C. T. Middlebrook, Jr.	Assistant engineer.	27	5 00 per day..	135 00	8 53	143 53
Geo. E. Greene	Assistant engineer.	237	5 00 per day..	1,185 00	4 55	1,189 55
W. L. Curtis	Assistant engineer.	242	5 00 per day..	1,210 00	226 42	1,436 42
O. S. Wilson	Assistant engineer.	207	5 00 per day..	1,035 00	77 58	1,112 58
H. A. Van Alstyne	Assistant engineer.	8	5 00 per day..	40 00	13 09	53 09
Austin T. Byrne	Assistant engineer.	35	5 00 per day..	175 00	37 18	212 18
G. O. House	Assistant engineer.	273	5 00 per day..	1,365 00	94 38	1,459 38
N. F. Hopkins	Assistant engineer.	252	5 00 per day..	1,260 00	137 48	1,397 48
G. C. Ward	Assistant engineer.	95	5 00 per day..	475 00	47 47	522 47
C. H. Flanigan	Leveler in charge.	190	5 00 per day..	950 00	184 58	1,134 58
D. D. Waldo	Leveler in charge.	122	5 00 per day..	610 00	122 82	732 82
E. A. Sommer	Leveler in charge.	200	5 00 per day..	1,000 00	136 39	1,136 39
H. K. Bishop	Leveler in charge.	227	5 00 per day..	1,135 00	97 56	1,232 86
N. F. Hopkins	Leveler	39	4 50 per day..	175 50	.....	175 50
H. D. Alexander	Leveler	244	4 50 per day..	1,098 00	.....	1,098 00
T. J. Morrison	Leveler	280	4 50 per day..	1,260 00	46 38	1,306 38
Geo. J. Lord	Leveler	313	4 50 per day..	1,408 50	170 77	1,579 27
E. A. Sommer	Leveler	85	4 50 per day..	382 50	77 94	460 44
H. K. Bishop	Leveler	83	4 50 per day..	373 50	62 48	435 98
Wm. Crennell, Jr.	Leveler	277	4 50 per day..	1,246 50	30 34	1,276 84
G. O. House	Leveler	35	4 50 per day..	157 50	17 99	175 49
D. D. Waldo	Leveler	49	4 50 per day..	220 50	84 19	304 69
Carl Bannister	Leveler	216	4 50 per day..	972 00	75 78	1,047 78
Carl L. Lund	Leveler	27	4 50 per day..	121 50	9 71	131 21
Jos. B. Barrett	Leveler	220	4 50 per day..	990 00	10 80	1,000 80
Chas. G. Moore	Leveler	203	4 50 per day..	913 50	15 63	929 13

Fred F. Gordon	Leveler	176	4 50 per day..	792 00	5 40	797 40
Chas. E. Cleaver.....	Leveler	133	4 50 per day..	598 50	1 63	600 13
W. W. Gilbert.....	Leveler	117	4 50 per day..	526 50	.....	526 50
Irving Hawkins.....	Leveler	40	4 50 per day..	180 00	2 45	182 45
Chas. M. Edwards	Leveler	116	4 50 per day..	522 00	1 36	523 36
E. R. Payne	Leveler	104	4 50 per day..	468 00	16 48	484 48
F. A. Snyder.....	Leveler	107	4 50 per day..	481 50	39 47	520 97
E. P. Lincoln	Leveler	176	4 50 per day..	792 00	15 32	807 32
W. C. Farrington	Leveler	94	4 50 per day..	423 00	17 91	440 91
M. O. Wood.....	Leveler	98	4 50 per day..	441 00	21 88	462 88
H. G. McKelvey.....	Draftsman	193	4 00 per day..	772 00	80	772 80
C. A. Poole	Draftsman	217	4 00 per day..	868 00	5 14	873 14
Carl Bannister	Rodman.....	66	3 50 per day..	231 00	3 10	234 10
Jas. Thomson.....	Rodman.....	176	3 50 per day..	616 00	5 80	621 80
F. W. Hamilton.....	Rodman.....	205	3 50 per day..	717 50	17 69	735 19
Isaac O. Cole	Rodman.....	252	3 50 per day..	882 00	10 29	892 29
Chas. M. Smith	Rodman.....	187	3 50 per day..	654 50	3 64	658 14
E. R. Payne	Rodman.....	46	3 50 per day..	161 00	10 82	171 82
S. D. Enoch	Rodman.....	190	3 50 per day..	665 00	31 18	696 18
Irving Hawkins.....	hodman.....	60	3 50 per day..	210 00	6 29	216 29
Ray Morris	Rodman.....	169	3 50 per day..	591 50	16 01	607 51
Chas. E. Cleaver	Rodman.....	39	3 50 per day..	136 50	.....	136 50
Jos. B. Barrett.....	Rodman.....	16	3 50 per day..	56 00	.....	56 00
A. H. Wilcox	Rodman.....	66	3 50 per day..	231 00	.....	231 00
Jos. W. Howe.....	Rodman.....	164	3 50 per day..	574 00	6 44	580 44
Paul A. Meyer	Rodman.....	206	3 50 per day..	721 00	16 61	737 61
F. L. Hurlbut.....	Rodman.....	142	3 50 per day..	497 00	24 66	521 66
Clinton J. Bean.....	Rodman.....	207	3 50 per day..	724 50	26 33	750 83
M. W. Tuttle	Rodman.....	122	3 50 per day..	427 00	5 00	432 00
G. L. Van Duseu.....	Rodman.....	153	3 50 per day..	535 50	35 87	571 37
M. S. McDiarmid.....	Rodman.....	123	3 50 per day..	430 50	62	431 12
Ray S. Palmer	Rodman.....	155	3 50 per day..	542 50	2 07	544 57
Max L. Blum	Rodman.....	125	3 50 per day..	437 50	3 67	441 17
G. D. Helmick.....	Rodman.....	97	3 50 per day..	339 50	29 52	360 02
Geo. A. Ensign.....	Rodman.....	116	3 50 per day..	406 00	13 88	419 88
Fred D. Haak.....	Chainman.....	289	5 00 per day..	1,445 00	214 66	1,659 66
R. T. Webster	Chainman.....	179	3 50 per day..	626 50	38 36	664 86
Walter Dubey.....	Chainman.....	202	3 50 per day..	707 00	3 99	710 99
Wm. Schneider.....	Chainman.....	195	3 50 per day..	682 50	75	683 25

Extraordinary Repairs—Canal Improvement—(Concluded).

NAME.	Rank.	Number of days.	Rate of compensation.	Salary.	Travel.	Total.
James S. Cook.....	Chainman.....	133	\$3 50 per day..	\$465 50	\$2 55	\$468 05
F. G. Moses.....	Chainman.....	210	2 50 per day..	525 00	8 40	533 40
A. W. Peters.....	Chainman.....	118	2 50 per day..	295 00	13 76	308 76
F. W. Gerstner.....	Chainman.....	193	2 50 per day..	482 50	9 50	492 00
R. W. Swanton.....	Chainman.....	210	2 50 per day..	525 00	4 75	529 75
James S. Cook.....	Chainman.....	132	2 50 per day..	330 00	45 72	375 72
A. H. Wilcox.....	Chainman.....	68	2 50 per day..	170 00	.....	170 00
E. J. Greiner.....	Chainman.....	193	2 50 per day..	482 50	5 85	488 35
Tracy B. Smith.....	Chainman.....	300	2 50 per day..	750 00	54 71	804 71
Clinton J. Bean.....	Chainman.....	67	2 50 per day..	167 50	3 40	170 90
John T. Dowd.....	Chainman.....	213	2 50 per day..	532 50	40 86	573 36
F. V. Searles.....	Chainman.....	271	2 50 per day..	677 50	42 09	719 59
F. Maerman.....	Chainman.....	158	2 50 per day..	395 00	4 19	399 19
H. C. Schermerhorn.....	Chainman.....	157	2 50 per day..	392 50	11 11	403 61
T. Beaupre.....	Chainman.....	154	2 50 per day..	385 00	5 10	390 10
G. M. Parce.....	Chainman.....	149	2 50 per day..	372 50	5 56	378 06
H. C. Brown.....	Chainman.....	182	2 50 per day..	455 00	6 01	461 01
Fred D. Davis.....	Chainman.....	237	2 50 per day..	592 50	4 17	596 67
F. H. Lomax.....	Chainman.....	157	2 50 per day..	392 50	14 17	406 67
Fred A. Bean.....	Chainman.....	156	2 50 per day..	390 00	27 21	417 21
R. B. McDonald.....	Chainman.....	246	2 50 per day..	615 00	21 76	636 76
Chas. F. Swain.....	Chainman.....	153	2 50 per day..	382 50	9 25	391 75
H. H. Albright.....	Chainman.....	155	2 50 per day..	387 50	11 70	399 20
H. A. Knapp.....	Chainman.....	114	2 50 per day..	285 00	9 71	294 71
Dan D. Mead.....	Chainman.....	191	2 50 per day..	477 50	37 26	514 76
Lewis G. Fisher.....	Chainman.....	8	2 50 per day..	20 00	.....	20 92
A. B. Marden.....	Chainman.....	95	2 50 per day..	237 50	7 58	245 08
C. E. Whitche.....	Chainman.....	68	2 50 per day..	170 00	96	170 96
						\$63,052 49

<i>Incidental expenses.</i>	
Labor	6,875 08
Livery	3,294 00
Stationery	607 51
Fuel and light	323 62
Office rent	1,214 53
Telegraph and telephone	605 07
Postage.....	28 70
Miscellaneous	3,573 18
	<hr/>
	\$79,574 18

SUMMARY.

EXTRAORDINARY REPAIRS.	AUTHORIZED BY		Amount.
	Chap.	Laws.	
Ordinary repairs	435	1897	\$8,473 80
Monroe avenue bridge, Rochester	207	1897	1,408 63
Exchange street bridge, Rochester	607	1898	2,701 92
Waste weirs at Lockport, Middleport and near Mabies bridge	542	1895	1,034 51
Deepening and improving Elghteen-mile creek	572	1897	1,082 79
Culverts Nos. 78 and 94	791	1897	162 02
Culverts Nos. 42, 43, 45 and 56	947	1896	90 00
Erie street bridge, Buffalo	566	1897	650 00
Bridge over Oak Orchard creek feeder, Medina	611	1898	578 45
Bridge over canal feeder at Medina	791	1896	129 82
State Court of Claims	790	1897	1,488 79
Improving channel leading from State culvert under Erie canal at Brockport	606	1898	271 50
Culverts Nos. 1 and 2	790	1896	1,865 58
Fitzhugh street bridge, Rochester	947	1897	712 50
South Clinton street bridge, Rochester	566	1897	483 62
Deepening and improving Cayuga creek	947	1896	316 45
Deepening and improving Mud creek	566	1897	467 44
Bridge over Allegany river between Carrollton and Allegauy	32	1898	62 41
Removing obstructions, etc., from Chemung river at Corning	339	1897	411 17
Dredging Bear lake	559	1897	74 85
Protecting unfinished work under general improvement	477	1896	807 83
	552	1898	
	790	1897	
	790	1897	
	606	1898	
	506	1898	

Southport road, Chemung county	115	1898	20 40
Enlarging spillway of Cuba reservoir	607	1898	72 74
Improving Glen creek, Watkins	624	1898	143 28
Buffalo Hamburg road, Erie county	115	1898	857 58
Ridge road, Monroe county	115	1898	688 63
East avenue road, Monroe county	115	1898	369 44
River road, Erie county	115	1898	127 99
Improving Newtown creek	949	1896	367 95
	791	1897	
	607	1898	
Dyke along Chemung river, Elmira	950	1896	251 11
Hamilton street bridge, Buffalo	790	1897	525 85
Improving highway Allegany Indian Reservation	568	1897	130 54
Improving highway Tonawanda Indian Reservation	790	1897	99 51
Lift bridge at Brighton	606	1898	558 35
New Home bridge	618	1898	67 70
	630	1898	
	79	1895	
Canal improvement	794	1896	79,574 18
	43	1897	
	569	1897	
			\$107,129 33

CANAL IMPROVEMENT WORK.
New York State Canals—Western Division.

CONTRACT.	MATERIAL EXCAVATED TO DATE.			MATERIAL REMAINING TO EXCAVATE.		
	CUBIC YARDS.		Shale and hard-pan.	CUBIC YARDS.		Shale and hard-pan.
	Earth.	Rock.		Earth.	Rock.	
1.....	268,231.4	100,997.8	10,354.0	.....	.....	.....
2.....	238,176.0	2,271.1	1,648.9	422,000	.....	2,000
3.....	63,791.0	33,396.0	500.0	184,000	127,000	.....
5.....	151,158.0	348.0	20,132.0	300,000	.....	15,000
6.....	58,745.0	11,326.0	0.0	192,500	2,000	.....
7.....	46,250.0	9,700.0	0.0	160,000	2,200	.....
8.....	38,882.0	18,080.0	2,406.0	171,400	1,000	73,000
9.....	64,041.0	0.0	18,618.0	81,200	.....	18,700
10.....	43,429.0	4,135.0	9,310.0	109,000	14,600	22,000
11.....	37,601.0	11,395.0	3,005.0	83,400	4,000	2,000
12.....	22,900.0	6,777.0	6,223.0	107,760	.....	1,940
13.....	71,600.0	3,950.0	14,550.0	114,500	4,000	12,300
14.....	36,800.0	3,500.0	350.0	111,000	6,500	.....
15.....	81,380.0	6,569.0	1,231.0	22,495	1,350	.....
17.....	0.0	0.0	0.0	207,900	.....	14,500
20.....	0.0	0.0	0.0	138,500	2,500	17,500
21.....	0.0	0.0	0.0	97,000	.....	10,000
22.....	0.0	0.0	0.0	186,900	.....	7,000
25.....	0.0	0.0	0.0	85,500	11,000	.....
26.....	0.0	0.0	0.0	253,300	.....	37,000
	1,222,984.4	212,444.9	88,327.9	2,971,365	170,150	280,940

Note that of the material excavated to date hard-pan represents only 6 1/2 % of the total earth and rock excavation, or 7 1/2 % of the total earth excavation; also that rock represents 17 1/2 % of the total earth excavation against 4 1/2 % remaining to take out, indicating that the most expensive portion of the excavation is, completed

Note that of the material remaining to excavate, hard-pan only represents 7 1/2 % of the total rock and earth excavation, or 3 % of the total earth excavation and that rock only represents 4 1/2 % of the remaining earth excavation.

WESTERN DIVISION--ERIE CANAL.

Culverts.

NUMBER.	Miles.	Kind.	Opening			Location.	Condition.
			No.	Size.	Area.		
1.....	0.26	C. I. pipe..	3	36"	31.20	1,914' W. Br. No. 1.....	New, 1898.
2.....	1.49	C. I. pipe..	3	36"	31.20	1,378' E. Br. No. 2.....	New, 1898.
3.....	2.16	Stone box ..	1	3' x 8'	9.00	2,532' W. Br. No. 3.....	Rebuilt enda.
4.....	2.13	Stone arch ..	1	4' chord ..	10.28	4,663' E. Br. No. 3.....	Rebuilt enda.
5.....	3.70	Stone arch ..	1	6' chord ..	20.14	1,638' E. Br. No. 3.....	Good.
6.....	4.84	Stone arch ..	1	6' chord ..	20.14	1,738' W. N. Y. C.....	Fair.
7.....	6.26	Wood box ..	1	3' x 2'	4.00	1,036' E. Br. No. 4.....	T. P. culvert.
8.....	6.28	Stone arch ..	1	4' chord ..	10.28	910' E. Br. No. 4.....	Leaky trunk.
9.....	6.40	C. I. pipe..	1	4' diameter.	.....	277' E. Br. No. 4.....	.....
10.....	6.46	Stone sewer.....	1	2' x 4'	8.00	36' W. Br. No. 4.....	Inaccessible.
11.....	6.93	C. I. pipe ..	1	24" diameter ..	3.14	1,061' W. Br. No. 5.....	Repair enda.
12.....	7.63	Stone arch ..	3	10' chord ..	98.54	1,343' E. Br. No. 6.....	Rebuilt enda.
13.....	8.35	C. I. pipe ..	1	24" diameter.....	8.14	.....	Rebuilt enda.
14.....	10.14	Composite ..	4	4' x 3'	46.00	.....	Trunk poor.
15.....	10.58	Composite ..	3	4' x 3'	24.00	.....	Berme end poor.
16.....	12.33	Stone arch ..	1	10' chord ..	49.27	.....	Fair.
17.....	15.16	Composite ..	1	3' x 3'	6.00	.....	Leaky trunk.
18.....	15.49	Stone b x ..	1	3' x 3'	6.00	.....	Rebuilt enda.
19.....	16.44	Composite ..	1	3' x 3'	6.00	.....	Light repairs.
20.....	17.17	Stone arch ..	1	4' chord ..	10.28	.....	Good.
21.....	18.57	Stone arch ..	1	4' chord ..	10.28	.....	Fair.
22.....	20.31	Stone arch ..	1	2' chord ..	25.18	.....	Good.
23.....	22.69	Stone arch ..	1	2' chord ..	14.14	.....	Clean out.
24.....	26.56	Stone arch ..	1	6' chord ..	20.14	.....	Rebuilt enda.
25.....	27.71	Stone arch ..	1	10' chord ..	49.27	.....	Good.
26.....	28.37	Stone arch ..	1	6' chord ..	.....	.....	Fair.
27.....	28.15	Composite ..	3	3' x 2'	12.00	1,134' E. Lock No. 61.....	Bad order.
28.....	28.26	Wood box ..	1	3' x 2'	6.00	West Br. No. 40.....	T. P. culvert.
29.....	29.03	C. I. pipe ..	5	48" diameter.....	50.26	2,500' E. Br. No. 44.....	New, 1898.
30.....	41.69	C. I. pipe ..	1	30" diameter.....	4.91	2,800' W. Br. No. 47.....	New, 1898.
31.....	42.76	Stone arch ..	1	4' chord ..	13.48	360' E. Br. No. 48.....	T. P. culvert.
32.....	44.03	Stone arch ..	1	6' chord ..	26.14	900' E. Br. No. 50.....	Fair.
33.....	45.00	Stone arch ..	1	23' chord ..	207.74	Irondequoit creek.....	Good.
34.....	46.79	Composite ..	1	3' x 3'	4.00	1,110' E. Br. No. 53.....	Renew.
35.....	47.11	C. I. pipe ..	1	30" diameter.....	3.26	1,000' E. Br. No. 54.....	New, 1898.

* Miles from Wayne county line.

WESTERN DIVISION—ERIE CANAL—Culverts—(Continued).

NUMBER.	Miles.	Kind.	OPENING.			Location.	Condition.
			No.	Size.	Area.		
33.....	48.21	Stone arch.....	1	12' chord.....	68.55	2,469' W. Br. No. 55.....	Repaired, 1896.
34.....	48.64	Stone arch.....	1	4' chord.....	10.28	3,811' E. Br. No. 56.....	Repaired, 1896.
35.....	50.65	Stone arch.....	1	12' chord.....	93.55	5,891' W. Lock No. 62.....	Repaired, 1896.
36.....	51.34	C. I. pipe.....	{ 3	24" diameter.....	6.28 }	5,565' E. Lock No. 63.....	Rebuilt, 1897.
37.....	51.45	Wood box ..	{ 2	36" diameter.....	14.14 }		Fair.
38.....	52.05	Stone arch.....	1	2' x 2'.....	4.01	2,850' E. Lock No. 63.....	Repaired, 1897.
	52.33	C. I. pipe.....	1	4' chord.....	14.28	1,770' E. Lock No. 63.....	T. P. culvert.
	52.90	C. I. pipe.....	1	10" diameter.....	0.52	264' E. Lock No. 63.....	T. P. culvert.
I.....	55.48	Stone box.....	1	10" diameter.....	0.52	59' E. Lock No. 64.....	Rochester sewer.
I 1/2.....	56.03	Stone arch.....	1	3' x 4'.....	12.00	Under Br. No. 64.....	Rochester sewer.
II.....	56.22	Stone box.....	1	2 3/4' diameter.....	5.94	Under Br. No. 73.....	Rochester sewer.
III.....	56.44	Iron pipe.....	1	3' x 3 1/2'.....	10.50	150' W. Br. No. 75.....	Rochester sewer.
III 1/2.....	56.92	Stone arch.....	1	24" diameter.....	8.14	125' W. Br. No. 77.....	Rochester sewer.
IV.....	56.65	Stone arch.....	1	3 3/4' diameter.....	11.04	53' W. Br. No. 79.....	Rochester sewer.
V.....	57.32	Stone arch.....	1	5' chord.....		256' W. Br. No. 79.....	Rochester sewer.
VI.....	57.60	Wood box.....	1	5' chord.....		1,108' W. Br. No. 83.....	Rochester sewer.
39.....	58.10	Stone arch.....	1	3' x 3'.....	6.00	594' W. Br. No. 84.....	Rochester sewer.
40.....	58.65	C. I. pipe.....	1	10' chord.....	67.27	690' F. Br. No. 85.....	New, 1897.
41.....	59.40	Stone arch.....	1	48" diameter.....	12.56	520' E. Br. No. 86.....	Rebuild ends.
42.....	59.74	Stone arch.....	1	4' chord.....	14.78	917' E. Br. No. 88.....	Repaired, 1898.
43.....	62.47	Stone arch.....	1	4' chord.....	8.78	855' W. Br. No. 88.....	Repaired, 1898.
44.....	62.59	Stone arch.....	1	7 1/2' chord.....	33.34	631' W. Br. No. 91.....	Rebuild ends.
45.....	63.40	Stone arch.....	1	4' chord.....	10.28	444' E. Br. No. 92.....	Repaired, 1898.
46.....	65.58	Stone arch.....	1	4' chord.....	14.28	1,354' E. Br. No. 93.....	Rebuild ends.
47.....	67.45	Stone arch.....	1	4' chord.....	10.28	2,754' E. Br. No. 96.....	Rebuild ends.
48.....	67.98	Composite.....	1	12' chord.....	68.55	589' E. Br. No. 94.....	Fair.
49.....	68.30	Stone arch.....	1	4' x 8'.....	12.00	847' W. Br. No. 99.....	Rebuild ends.
50.....	68.73	Stone arch.....	1	4' chord.....	10.28	2,590' E. Br. No. 100.....	Rebuild ends.
51.....	69.00	Stone arch.....	1	4' chord.....	10.28	307' E. Br. No. 100.....	Rebuild ends.
52.....	70.31	Stone arch.....	1	4' chord.....	10.28	731' E. Br. No. 101.....	Rebuild ends.
53.....	70.47	Stone arch.....	1	4' chord.....	10.24	757' W. Br. No. 102.....	Rebuild.
54.....	70.72	Stone arch.....	1	6' chord.....	20.14	125' E. Br. No. 103.....	Repair ends.
55.....	72.03	Composite ..	1	12' chord.....	104.55	1,196' W. Br. No. 103.....	Rebuild
55 1/2.....	72.83	C. I. pipe.....	1	4' x 8'.....	12.00	2,406' W. Br. No. 104.....	New, 1893.
56.....	73.26	Composite ..	1	15".....	1.22	279' E. Br. No. 106.....	Being rebuilt.
57.....	74.12	Stone arch.....	1	4' x 8'.....	12.00	2,205' W. Br. No. 106.....	Rebuild ends.
58.....	74.86	Stone arch.....	1	4' chord.....	16.48	3,869' E. Br. No. 107.....	New, 1891.
		Stone arch.....	1	4' chord.....	10.28	3,535' E. Br. No. 107.....	

58 1/2	75.61	Stone arch	1	4' chord	18.28	470' W. Br. No. 100	New, 1891.
59	76.49	Composite	1	4' x 8'	19.00	1,161' E. Br. No. 110	Rebuild.
60	76.69	Stone box	1	4' x 8'	19.00	51' E. Br. No. 110	No record.
61	77.36	Stone arch	1	6' chord	20.14	3,922' E. Br. No. 111	Rebuild ends
62	77.85	Composite	1	3' x 2'	6.00	1,319' E. Br. No. 111	Replace C. I. P.
63	78.38	Stone arch	1	6' chord	18.34	70' W. Br. No. 112	Rebuild ends.
64	78.97	Stone arch	1	4' chord	11.08	1,651' E. Br. No. 113	Good; clean out.
65	79.50	Stone arch	1	12' chord		1,178' W. Br. No. 113	Fair.
66	80.02	Stone arch	1	11' chord		Old canal, Sandy creek	T. P. end bad.
67	80.69	Stone arch	1	4' chord	9.08	1,476' W. Br. No. 115	Repair ends.
68	81.06	Stone arch	1	4' chord	18.08	1,431' W. Br. No. 116	Repair ends.
69	82.44	Stone arch	1	4' chord	6.88	994' E. Br. No. 117	Rebuild ends.
70	83.18	Stone arch	1	10' chord		1,906' E. Br. No. 119	Clean out.
71	83.97	Stone arch	1	4' chord	7.08	1,527' W. Br. No. 119	Rebuild ends; clean.
72	85.00	Stone arch	2	19' chord	168.30	972' E. Br. No. 120	Rebuild ends; clean.
73	86.28	Stone arch	1	6' chord	20.14	408' W. Br. No. 121	Fair.
74	87.04	Stone arch	1	4' chord	10.28	830' E. Br. No. 123	Rebuild ends; clean.
75	87.96	Stone box	1	4' chord	10.28	545' E. Br. No. 124	Rebuild.
76	88.35	Stone arch	1	2 1/4' x 2 1/4'	6.25	171' E. Br. No. 125	Rebuild
77	88.99	Stone arch	1	12' chord	10.28	1,518' E. Br. No. 126	Rebuild ends.
78	89.42	Stone box	2	12' chord	209.10	1,879' W. Br. No. 126	Rebuild.
79	89.60	Stone box	1	3' x 8'	9.00	1,185' E. Br. No. 127	Fair.
80	89.60	Composite	1	2 1/4' x 8'	7.50	29' W. Br. No. 128	Good.
81	89.98	Composite	1	4' x 8'	12.00	997' W. Br. No. 128	Fair.
82	90.16	Stone arch	1	4' x 8'	12.00	2,765' E. Br. No. 129	Replace C. I. P.
83	90.46	Composite	1	4' chord	15.08	1,805' E. Br. No. 129	Rebuild ends.
84	90.83	Composite	1	4' x 3'	12.00	201' E. Br. No. 129	Fair.
85	91.60	Composite	1	4' x 8'	12.00	1,541' E. Br. No. 130	Repair wings
86	92.23	Stone arch	1	4' x 8'	13.00	2,561' W. Br. No. 130	Replace C. I. P.
87	92.53	Composite	1	11 1/4' chord		2,349' E. Br. No. 131	Repair ends.
88	92.82	Stone arch	1	4' x 8'	12.00	771' E. Br. No. 131	Replace C. I. P.
89	93.27	Stone arch	1	8' chord	20.18	818' W. Br. No. 131	Repair ends.
90	94.20	Stone arch	1	4' chord	15.08	726' W. Br. No. 132	Good.
91	95.15	Composite	1	4' chord	10.28	1,547' W. Br. No. 134	Rebuild ends.
92	95.75	Stone arch	1	4' x 8'	12.00	3,040' E. Br. No. 135	Fair.
93	95.85	Stone arch	1	6' chord		184' W. Br. No. 135	Rebuild.
94	96.71	C. I. pipe	1	4' chord	14.28	660' W. Br. No. 135	Repair ends; clean.
95	97.20	Stone arch	1	48" diameter	12.56	5,187' W. Br. No. 135	New, 1898.
96	97.32	Stone arch	2	12' chord	233.10	4,637' E. Br. No. 136	Repair ends.
97	98.08	Stone arch	1	19' chord	426.08	4,090' E. Br. No. 136	Rebuild, 1898.
98	98.48	Composite	1	4' chord	14.28	69' E. Br. No. 136	Rebuild ends.
99	100.19	Stone box	1	4' x 8'	12.00	2,041' W. Br. No. 136	Fair.
100	101.10	Composite	1	2' x 2'	4.00	53' W. Br. No. 140	Medina sewer.
101	101.65	Composite	1	4' x 2'	8.00	3,838' W. Br. No. 140 1/2	Fair; clean.
102	102.46	Stone arch	1	6' chord	26.14	1,118' W. Br. No. 141	Fair.
103	103.84	Stone arch	1	4' chord	14.28	413' E. Br. No. 142	Repair end; clean.
104	104.56	Composite	1	12' chord	128.55	1,600' W. Br. No. 142	Repair wings.
			1	4' x 8'	13.00	2,580' E. Br. No. 144	Replace C. I. P.

* Miles from Wayne county line.

WESTERN DIVISION—ERIE CANAL—Culverts—(Continued).

NUMBER.	*Miles	Kind.	OPENING.			Area.	Location.	Condition.
			No.	Size.				
105.....	105.00	Composite.....	1	4' x 2'.....	8.00	214' E. Br. No. 144.....	Replace C. I. P.	
106.....	105.23	Composite.....	1	3' x 2 3/4'.....	8.26	670' W. Br. No. 145.....	Rebuild.	
107.....	105.29	Stone arch.....	2	12 chord.....	185.10	938' W. Br. No. 145.....	Repair wing.	
108.....	105.23	Composite.....	1	4' x 3'.....	12.00	297' E. Br. No. 146.....	Replace C. I. P.	
109.....	106.84	Stone arch.....	1	9' chord.....	90.36	1,088' W. Br. No. 147.....	Rebuild ends.	
110.....	108.15	Stone arch.....	1	4' chord.....	13.68	218' E. Br. No. 148.....	Rebuild ends.	
111.....	108.66	Stone arch.....	1	4' chord.....	14.23	649' E. Br. No. 149.....	Rebuild ends.	
112.....	108.99	Composite.....	1	4' x 3'.....	12.00	1,093' W. Br. No. 149.....	Fair.	
113.....	109.57	Stone arch.....	1	18' chord.....	127.23	480' W. Br. No. 150.....	Fair.	
114.....	110.16	Composite.....	1	4' x 2'.....	8.00	1,227' E. Br. No. 151.....	Replace C. I. P.	
115.....	110.52	Composite.....	1	4' x 4'.....	16.00	664' W. Br. No. 151.....	Fair	
115 1/2.....	110.84	C. I. pipe.....	1	12" diameter.....	0.78	2,363' W. Br. No. 151.....	Good.	
116.....	111.94	Composite.....	1	4' x 3'.....	12.00	2,960' W. Br. No. 152.....	Replace C. I. P.	
117.....	112.22	Stone arch.....	1	4' chord.....	10.23	4,238' W. Br. No. 152.....	Fair. Clean.	
118.....	112.65	Stone arch.....	1	6' chord.....	26.14	3,866' E. Br. No. 153.....	Good.	
119.....	113.50	Stone arch.....	1	6' chord.....	26.14	623' W. Br. No. 153.....	Rebuild ends.	
120.....	114.02	Stone arch.....	1	6' chord.....	25.24	1,202' E. Br. No. 154.....	Repair end. Clean.	
121.....	114.48	Stone arch.....	1	4' chord.....	11.92	1,285' W. Br. No. 154.....	Fair. Clean.	
122.....	114.86	Stone arch.....	1	4' chord.....	10.28	1,619' E. Br. No. 155.....	Rebuild ends. Clean.	
123.....	115.56	Wood box.....	1	4' x 8'.....	12.00	1,166' E. N. Y. C.....	Good.	
124.....	116.26	Stone arch.....	1	4' chord.....	8.88	30' E. Br. No. 158.....	Fair. Clean.	
125.....	116.40	Stone arch.....	1	12' chord.....	74.60	241' W. Br. No. 159.....	Fair.	
126.....	116.53	Stone box.....	1	4' x 4'.....	16.00	69' E. Br. No. 160.....	Good.	
Tunnel.....	117.35	.....	.....	.....	.....	116' W. Lock No. 71.....	Good.
127.....	119.65	Stone box.....	1	3' x 5'.....	15.00	1,888' E. Br. No. 166.....	Good.	
127 1/2.....	119.76	Open sluice.....	1	8' wide.....	.....	1,311' E. Br. No. 163.....	Rebuild.
128.....	120.70	Stone box.....	1	3' x 5'.....	15.00	1,140' E. Br. No. 167.....	Good.	
+ "X".....	.....	C. I. pipe.....	1	4' diameter.....	12.66	1,941' W. Br. No. 167.....	Good. Drop culvert.
128 1/2.....	121.63	Stone box.....	1	4' x 3'.....	12.00	2,704' E. Guard lock.....	Good.	
+ "XX".....	.....	Stone box.....	2	3' x 5 1/2'.....	33.00	3,438' W. Guard lock.....	.....
129.....	125.81	C. I. pipe.....	6	72" diameter.....	169.72	422' W. Br. No. 180.....	New, 1897.	
130.....	128.20	C. I. pipe.....	1	48" diameter.....	13.56	840' S. Br. No. 183.....	New, 1897.	
131.....	142.64	C. I. pipe.....	4	60" diameter.....	78.62	622' E. Erie R. R.	New, 1897.	

* Miles from Wayne county line.

+ "X" May's drop culvert.

+ "XX" outlet State ditch.

RECAPITULATION.

1. The following culverts have been entirely or partially rebuilt and are now in good condition :

Numbers 1, 2, 26, 27, 32, 33, 34, 35, 36, 38, 40, 42, 43, 45, 55½, 58, 58½, 78, 94, 96, 129, 130 and 131.

NOTE.—Numbers 1, 2, 26, 27, 32, 36, 40, 94, 129, 130 and 131 were entirely rebuilt. Numbers 33, 34, 35, 38, 42, 43, 45 and 96 were partially rebuilt (new ends and arch lengthened). Number 78 a new concrete cover has been added. Number 55½ was built new in 1892. Numbers 58 and 58½ were built new in 1891.

2. The following culverts are in fair or good condition :

Numbers 5, 8, 14, 18, 20, 23, 23½, 25, *28, 29, 30, 37, 48, 65, 79, 80, 83, 89, 91, *98, 99, 101, 112, 115, 115½, 118, 123, 126, 127, 127½, 128, and 128½.

NOTE.—Number *28 towpath end rebuilt by section superintendent. Number *98 towpath end rebuilt by section superintendent in 1897.

3. The following culverts are in fair condition but need some repairs or cleaning out :

Numbers 6, 7, 9, 13, 15, 17, 19, 21, 54, 64, 69, 70, 71, 72, 73, 75, 84, 86, 88, 95, 100, 102, 103, 107, 113, 117, 120, 121, 122, 124 and 125.

4. The following culverts require new masonry ends :

Numbers 4, 10, 11, 22, 41, 44, 46, 47, 49, 50, 51, 52, 53, 57, 61, 63, 66, 67, 68, 74, 76, 77, 90, 92, 93, 97, 109, 110, 111, 119.

5. The following culverts should be replaced by new cast iron pipe culverts :

Numbers 3, 12, 16, 24, *31, 55, †56, 59, 62, 81, 82, 85, 87, 104, 105, 106, 108, 114 and 116.

6. The following culverts are sewers and are maintained by the city of Rochester, N. Y.:

Numbers I, I½, II, III, III½, IV, V, VI and XXXIX.

*To be rebuilt, contract number 5. †Contract let to rebuild.

WESTERN DIVISION—ERIE CANAL—Bridges.

Old number.	LOCAL NAME.	Use.	Style.	Material.	Clear span.	No roadways.	Clear width.	C. to C. trusses.	Number walks.	Clear width.	C to C. truss to railing.	Skew.	When erected.	Miles from Wayne county line.
1	Wayne county line	Highway.	Whipple truss	Wood and W. I.	71.35	1	13.20	15.00				Deg. Min.	1881	1.69
2	Pl. Lock	Highway.	Whipple arch	C. I. and W. I.	71.65	1	15.50	17.10					1893	4.02
3	Waldruft's	Highway.	Whipple arch	C. I. and W. I.	72.10	1	15.70	19.00					1890	4.34
4	West Shore R. R.	Railroad	Double Intersection Pratt	W. I.	158.60	*2		15.75				36 30 R.		4.51
5	New York Central R. R.	Railroad	Lattice	W. I.	110.00	*4		15.00				46 00 R.	1888	6.47
6	Glasgow st., Clyde.	Highway.	Lift	W. I.	75.00	1	21.26	22.02	2	5.80	6.15	9 00 R.	1885	6.56
7	Sodus st., Clyde	Highway.	Whipple arch	C. I. and W. I.	79.00	1	16.30	18.95	2	4.70	6.47	23 00 R.	1890	7.89
8	Slegman's.	Farm.	Whipple truss	Wood	71.70	1	11.20	13.00					1897	8.70
9	Barker's	Farm.	Whipple truss	Wood	71.05	1	11.50	13.00					1897	9.36
10	Long's	Farm.	Whipple truss	Wood	70.65	1	10.60	12.20					1897	9.36
11	Lock Berlin.	Highway	Whipple truss	W. I.	71.45	1	13.90	17.05					1881	10.71
12	Horton's	Highway	Lattice	C. I. and W. I.	71.40	1	15.20	17.00					1879	11.28
13	Goetzman's	Farm.	Whipple truss	Wood and W. I.	71.34	1	9.60	11.60					1881	11.75
14	Klaus'	Highway.	Whipple truss	Wood	73.35	1	15.35	17.00					1896	12.44
15	Richmond's	Highway.	Whipple truss	Wood	74.15	1	13.30	15.00					1895	12.79
16	Cole's	Highway.	Lattice	W. I.	73.43	1	14.30	17.00					1881	13.10
17	Geneva st., Lyons	Highway.	Whipple arch	C. I. and W. I.	84.65	1	16.50	18.90	2	4.50	5.20	16 45 R.	1856	13.95
18	Montezuma st., Lyons.	Highway.	Whipple arch	C. I. and W. I.	99.25	1	17.10	19.05	2	4.90	6.25	34 55 L.	1855	14.01
19	Water st., Lyons.	Highway.	Whipple arch	C. I. and W. I.	86.40	1	16.75	19.00	2	4.00	6.00	24 00 L.	1856	14.12
20	Leach's.	Highway.	Whipple arch	C. I. and W. I.	71.65	1	14.20	16.92					1872	14.31
21	Prime's	Farm.	Whipple truss	Wood	70.75	1	10.70	12.40					1896	15.48
22	Park's.	Highway.	Whipple truss	W. I.	81.30	1	14.60	17.00					1881	15.87
23	Mosher's.	Highway.	Lattice	W. I.	70.86	1	14.7	17.07					1881	16.92
24	New York Central R. R.	Railroad	Lattice	W. I.	150.20	*4		15.00						
25	Change	Change	Bowstring	C. I. and W. I.	150.85			15.55					1881	18.01
26	West Shore R. R.	Railroad	Pratt truss	W. I.	71.25	1	10.40	12.00				45 00 L.		
27	Lyons st., Newark.	Highway.	Whipple arch	C. I. and W. I.	127.20	*2		15.75				20 20 L.	1873	19.25
28	Northern Central R. R.	Railroad	Pratt truss	W. I.	98.20	1	16.65	19.00				29 45 L.		
29	Charles st., Newark	Highway.	Whipple arch	C. I. and W. I.	110.20	+1		16.10				6 40 R.	1856	19.92
30	Main st., Newark.	Highway.	Plate girder	W. I.	73.40	1	17.00	19.00					1897	20.06
31	Allerton's	Highway.	Whipple arch	C. I. and W. I.	81.70	1	28.60	32.00	2	7.20	8.00		1890	21.20
32	Peek's	Highway.	Whipple arch	C. I. and W. I.	70.60	1	14.55	17.05					1884	21.80
33	Swezey's	Highway.	Whipple arch	C. I. and W. I.	70.85	1	14.00	16.00					1898	22.49
34	Palmer's	Highway.	Whipple truss	Wood	74.00	1	13.35	15.20					1898	22.94
35	Port Gibson	Highway.	Whipple truss	Wood	71.15	1	14.85	16.67					1898	23.46
36	Galloway's.	Highway.	Whipple arch	C. I. and W. I.	86.10	1	16.60	19.00					1859	23.46
37	Kent st., Palmyra.	Highway	Lattice	W. I.	71.30	1	14.65	17.10					1881	26.02
38	Railroad av., Palmyra	Highway	Swartz truss	C. I. and W. I.	89.35	1	15.60	17.82						27.85
39	Market st., Palmyra.	Highway	Whipple arch	C. I. and W. I.	94.80	2	15.45	18.00	1	4.35	6.00	29 30 R.	1870	28.29
40		Highway	Whipple arch	C. I. and W. I.	80.00	1	16.90	18.00	1	4.65	6.15		1870	28.60

WESTERN DIVISION—ERIE CANAL—Bridges.

Old number.	LOCAL NAME.	Use.	Style.	Material.	Clear span.	No roadways.	Clear width.	C. to C. trusses.	Number walks.	Clear width.	C to C. truss to railing.	Skew.	When erected.	Miles from Wayne county line.
1	Wayne county line	Highway	Whipple truss	Wood and W. I.	71.85	1	13.20	15.00				Deg. Min.	1881	1.69
2	Pl. Lock	Highway	Whipple arch	C. I. and W. I.	71.65	1	15.50	17.10					1893	4.02
3	Waldruff's	Highway	Whipple arch	C. I. and W. I.	72.10	1	15.70	19.00					1890	4.34
4	West Shore R. R.	Railroad	Double Intersection Pratt	W. I.	158.60	*2		15.75				36 30 R.		4.61
5	New York Central R. R.	Railroad	Lattice	W. I.	110.00	*4		15.00				46 00 R.		6.47
6	Glasgow st., Clyde	Highway	Lift	W. I.	75.00	1	21.26	22.02	2	5.80	6.15	9 00 R.	1888	6.56
7	Sodus st., Clyde	Highway	Whipple arch	C. I. and W. I.	79.00	1	16.30	18.95	2	4.70	6.47	23 00 R.	1885	7.89
8	Slegman's	Farm	Whipple truss	Wood	71.70	1	11.20	13.00					1890	8.70
9	Barker's	Farm	Whipple truss	Wood	71.05	1	11.50	13.00					1897	9.36
10	Long's	Farm	Whipple truss	Wood	70.65	1	10.60	12.20					1897	10.71
11	Lock Berlin	Highway	Lattice	W. I.	71.45	1	13.90	17.05					1881	11.28
12	Horton's	Highway	Whipple arch	C. I. and W. I.	71.40	1	15.20	17.00					1879	11.75
13	Goetzman's	Farm	Whipple truss	Wood and W. I.	71.34	1	9.60	11.60					1881	12.44
14	Klaus'	Highway	Whipple truss	Wood	73.35	1	15.35	17.00					1896	12.79
15	Richmond's	Highway	Whipple truss	Wood	74.15	1	13.30	15.00					1895	13.10
16	Cole's	Highway	Lattice	W. I.	73.43	1	14.30	17.00					1881	13.45
17	Geneva st., Lyons	Highway	Whipple arch	C. I. and W. I.	84.65	1	16.50	18.90	2	4.50	5.20	16 45 R.	1856	14.01
18	Montezuma st., Lyons	Highway	Whipple arch	C. I. and W. I.	99.25	1	17.10	19.05	2	4.90	6.25	34 55 L.	1855	14.19
19	Water st., Lyons	Highway	Whipple arch	C. I. and W. I.	86.40	1	16.75	19.00	2	4.00	6.00	24 00 L.	1856	14.31
20	Leach's	Highway	Whipple arch	C. I. and W. I.	71.65	1	14.20	16.94					1872	15.48
21	Prime's	Farm	Whipple truss	Wood	70.75	1	10.70	12.40					1896	15.67
22	Park's	Highway	Lattice	W. I.	81.30	1	14.60	17.00					1881	16.92
23	Mosher's	Highway	Lattice	W. I.	70.86	1	14.7	17.07					1881	16.92
24	New York Central R. R.	Railroad	Lattice	W. I.	150.20	*4		15.00						18.01
25	Change	Change	Bowstring	C. I. and W. I.	150.85			15.55					1881	18.01
26	West Shore R. R.	Railroad	Pratt truss	W. I.	71.25	1	10.40	12.00				45 00 L.		19.25
27	Lyons st., Newark	Highway	Whipple arch	C. I. and W. I.	98.20	*2		15.75				20 20 L.	1875	19.25
28	Northern Central R. R.	Railroad	Pratt truss	W. I.	110.20	+1		16.65				29 45 L.		19.92
29	Charles st., Newark	Highway	Whipple arch	C. I. and W. I.	73.40	1	17.00	16.10				6 40 R.	1856	20.06
30	Main st., Newark	Highway	Plate girder	W. I.	81.70	1	28.60	32.00	2	7.20	8.00		1897	21.20
31	Allerton's	Highway	Whipple arch	C. I. and W. I.	70.60	1	14.55	17.00					1890	21.80
32	Peek's	Highway	Whipple arch	C. I. and W. I.	70.85	1	14.85	16.00					1884	22.49
33	Swezey's	Highway	Whipple truss	Wood	72.00	1	18.85	15.20					1898	22.94
34	Palmer's	Highway	Whipple truss	Wood	71.15	1	14.95	16.67					1898	23.46
35	Port Gibson	Highway	Whipple arch	C. I. and W. I.	86.10	1	16.60	19.00					1859	24.02
36	Galloway's	Highway	Lattice	W. I.	71.30	1	14.65	17.10					1881	24.51
37	Kent st., Palmyra	Highway	Swarts truss	C. I. and W. I.	89.85	1	15.60	17.82						24.51
38	Railroad av., Palmyra	Highway	Whipple arch	C. I. and W. I.	94.80	2	15.45	18.00	1	4.85	6.00	20 30 L.	1870	24.51
39	Market st., Palmyra	Highway	Whipple arch	C. I. and W. I.	80.00	1	16.90	18.00	1	4.65	6.15		1870	24.51

WESTERN DIVISION—ERIE CANAL—Bridges—(Continued).

Old number.	LOCAL NAME.	Use.	Style.	Material.	Clear span.	Number road-ways.	Clear width.	C. to C. trusses.	Number walks.	Clear width.	C. to C. truss to	Skew.	When erected.	Miles from Wayne county line.
79	Genesee Valley Canal	Towpath	Pipe	C. I. and W. I.	90.50	1	14.00	14.70	...	...	...	Deg. Min.	1873	56.83
	B. R. & P. R. R.	Railroad	Lattice	W. I.	136.26	+1	13.00	14.50	...	...	...	47 07 R.	...	56.70
80	N. Y. C. & H. R. R.	Railroad	Lattice	W. I.	96.75	4	13.60	15.00	...	...	...	29 30 R.	...	56.73
	Allen st., Rochester	Highw'y & El. R. R.	Lift	W. I.	68.40	1	19.00	20.10	2	5.40	...	1 30 L.	1879	56.74
81	Brown st., Rochester	Highway	Lift	W. I.	63.40	1	16.90	18.00	2	4.10	...	24 13 L.	1883	56.87
82	Jay st., Rochester	Highway	Whipple arch.	C. I. and W. I.	{ E. 84.50 W. 83.80 }	1	16.30	20.20	2	4.70	...	7 40 L.	1869	57.00
83	Smith st., Rochester	Highway	Lift	W. I.	78.40	1	17.20	18.00	2	5.00	...	19 30 R.	1890	57.13
	N. Y. C. R. R. (Old Falls Br.)	Railroad	Lattice	W. I.	125.70	+1	13.60	15.00	...	...	...	40 12 R.	...	57.41
84	Lyell av., Rochester	Highw'y & El. R. R.	Lift	W. I.	76.20	1	17.00	18.00	2	4.00	...	30 48 R.	1883	57.53
85	Emerson st., Rochester	Highway	Lift	W. I.	118.17	1	15.40	18.00	2	4.70	...	17 40 R.	1896	58.24
86	Lexington av., Rochester	Highway	Lift	W. I.	69.60	1	22.50	24.00	1	5.30	...	...	1893	58.78
	N. Y. C. & H. R. R.	Railroad	Lattice	W. I.	128.90	+1	...	15.50	...	...	...	41 22 L.	1885	58.84
	B. R. & P. R. R.	Railroad	Pratt	W. I.	104.20	+1	...	15.80	...	...	...	4 44 L.	1889	58.93
87	Change	Change	Bowstring	W. I.	82.85	1	10.50	13.00	...	...	...	...	1879	58.97
88	Scott's	Highway	Whipple truss	Wood and W. I.	81.70	1	13.15	15.30	...	...	...	20 3 L.	1877	59.59
89	Four Mile Grocery	Highway	Whipple truss	Wood	81.00	1	14.40	17.00	...	...	...	17 22 R.	1868	60.13
90	Spl'er's	Highway	Whipple trap truss	Wood and W. I.	80.57	1	14.50	16.90	...	...	...	10 30 R.	1876	62.10
91	Six Mile Grocery	Highway	Whipple trap truss	C. I. and W. I.	91.30	1	16.25	19.00	...	...	...	34 06 L.	1875	62.37
92	Douglas'	Farm	Whipple truss	Wood and W. I.	79.75	1	12.55	15.10	...	...	...	...	1875	62.99
93	Finley's	Highway	Whipple truss	Wood and W. I.	82.10	1	15.30	17.20	...	...	...	...	1877	63.64
94	South Greece	Highway	Whipple arch	Cast iron	91.00	1	17.00	19.00	...	...	...	20 3 R.	1896	63.95
95	Cromwell's	Highway	Whipple arch	C. I. and W. I.	80.66	1	14.75	17.15	...	...	...	38 33 L.	1875	65.04
96	Hiscock's	Highway	Whipple arch	C. I. and W. I.	80.45	1	14.10	16.20	...	...	...	...	1870	66.18
97	Norman's	Highway	Whipple truss	Wood and W. I.	81.10	1	12.70	15.20	...	...	...	...	1875	67.03
98	Union st., Spencerp't	Highway	Whipple arch	C. I. and W. I.	85.90	1	16.85	18.90	2	4.20	6.00	17 42 L.	1857	67.59
99	Amity st., Spencerp't	Highway	Whipple arch	C. I. and W. I.	94.26	1	16.35	18.60	...	...	...	31 45 L.	1873	67.79
100	Webster's, east	Highway	Whipple arch	C. I. and W. I.	82.70	1	14.10	16.20	...	...	...	...	1873	68.90
101	Webster's, west	Highway	Whipple arch	C. I. and W. I.	82.40	1	16.10	18.55	...	...	...	...	1873	69.15
102	Crissey's	Highway	Whipple trap truss	C. I. and W. I.	{ E. 80.30 W. 81.00 }	1	15.60	17.86	...	...	...	3 30 L.	1876	70.18
103	Adams' Basin	Highway	Whipple arch	C. I. and W. I.	81.70	1	16.80	19.00	2	5.00	6.70	6 30 L.	1857	70.53
104	Doty's	Highway	Whipple arch	C. I. and W. I.	82.90	1	14.60	17.00	...	...	...	...	1890	71.69
105	Brockway's	Highway	Whipple arch	C. I. and W. I.	81.75	1	15.60	18.15	...	...	...	...	1867	72.64
106	Cooley's Basin	Highway	Whipple arch	C. I. and W. I.	81.75	1	15.85	17.80	...	...	...	...	1867	72.96
107	Mechanic st., Brockp't.	Highway	Whipple arch	C. I. and W. I.	84.76	1	16.45	18.40	2	4.76	6.23	11 30 L.	1859	75.07
108	Main st., Brockp't.	Highway	Lift	W. I.	80.50	1	20.70	22.00	2	5.70	6.20	2 10 L.	1883	75.24
109	Smith st., Brockp't	Highway	Whipple arch	C. I. and W. I.	84.79	1	16.20	18.00	2	4.65	6.00	...	1870	75.53
110	Danforth's	Highway	Whipple arch	C. I. and W. I.	90.35	1	13.60	15.95	...	...	...	...	1855	76.73

111	Miner's	Highway	Lattice	W. I.	86.00	1	15.55	18.15	.....	.....	0	40 L.	1881	78.13
112	County line	Highway	Whipple arch	C. I. and W. I.	90.71	1	13.90	16.05	.....	.....	19	15 L.	1886	78.40
113	Orr's	Highway	Bowstring	W. I.	86.70	1	12.60	15.38	.....	.....	4	30 R.	1879	79.31
114	Frable's (old canal)	Highway	Whipple arch	C. I. and W. I.	80.25	1	10.75	18.10	.....	4.10	5	26 L.	1849	.....
115	Holley	Highway	Whipple arch	C. I. and W. I.	87.20	1	15.10	19.00	.....	.....	.....	.....	1857	79.78
116	McCarthy's	Highway	Whipple arch	C. I. and W. I.	87.15	1	15.60	18.10	.....	.....	8	20 L.	1871	80.45
117	Tuttle's	Highway	Swartz truss	C. I. and W. I.	88.40	1	15.25	17.20	.....	.....	.....	.....	1882	81.29
118	McGuire's	Highway	Whipple truss	Wood and W. I.	87.50	1	12.00	15.25	.....	.....	.....	.....	1876	81.78
119	Hulburton	Highway	Whipple arch	C. I. and W. I.	91.50	1	16.20	18.60	.....	3.90	12	15 R.	1856	82.85
120	Brockville	Highway	Whipple arch	C. I. and W. I.	92.45	1	13.60	16.50	.....	.....	13	44 L.	1871	84.20
121	Hindsburg	Highway	Whipple arch	C. I. and W. I.	91.10	1	15.60	18.65	.....	.....	11	20 R.	1856	84.96
122	Transit	Highway	Bowstring	W. I.	88.80	1	12.50	15.45	.....	.....	.....	.....	1879	85.46
123	Jaquith's	Highway	Whipple truss	Wood and W. I.	90.30	1	14.00	17.10	.....	.....	.....	.....	1876	86.48
124	Bidwell's	Highway	Whipple truss	Wood	89.70	1	13.40	15.10	.....	.....	.....	.....	1885	87.19
125	Bralley's	Highway	Swartz truss	C. I. and W. I.	89.70	1	15.65	17.40	.....	.....	8	33 R.	1883	88.08
126	Hall's	Highway	Whipple arch	C. I. and W. I.	91.30	1	15.00	19.10	.....	.....	5	32 R.	1856	88.68
127	Ingersoll st., Albion	Highway	Bollman	C. I. and W. I.	94.25	1	17.95	19.95	.....	3.70	18	24 L.	1835	89.29
128	Batavia st., Albion	Highway	Swing	W. I.	80.70	1	16.40	17.00	.....	4.90	.....	.....	1871	89.46
129	Lattin's	Highway	Whipple truss	Wood	106.75	1	11.80	13.80	.....	.....	28	09 L.	1896	90.55
130	Gaines' Basin	Highway	Lattice	W. I.	107.50	1	16.70	19.00	.....	.....	38	52 L.	1881	91.17
131	Eagle harbor	Highway	Whipple arch	C. I. and W. I.	103.40	1	16.80	19.00	.....	3.92	28	10 R.	1856	92.72
132	Starkweather's	Highway	Whipple truss	Wood	91.70	1	13.20	17.10	.....	.....	.....	.....	1885	93.10
133	Allen's	Highway	Whipple arch	C. I. and W. I.	92.20	1	15.60	17.80	.....	.....	8	40 R.	1880	93.47
134	Long's	Highway	Whipple truss	Wood	102.13	1	15.30	18.00	.....	.....	26	53 R.	1885	93.96
135	Knowlesville	Highway	Whipple arch	C. I. and W. I.	102.25	1	17.70	20.00	.....	4.20	25	5 R.	.....	95.73
136	Beal's	Highway	Whipple truss	Wood	91.15	1	13.00	15.00	.....	.....	3	50 R.	1885	96.15
137	Hastings	Highway	Whipple arch	C. I. and W. I.	94.35	1	15.53	18.00	.....	.....	20	21 R.	1877	96.94
138	Halloway's, Medina	Highway	Whipple arch	C. I. and W. I.	90.75	1	16.75	19.20	.....	.....	.....	.....	1869	99.53
139	Church st., Medina	Highway	Whipple arch	C. I. and W. I.	94.90	1	14.90	17.75	.....	4.60	1	18 R.	1850	99.96
140	Shelby st., Medina	Highway	Whipple arch	C. I. and W. I.	90.95	1	16.70	19.20	.....	4.30	0	18 R.	1855	100.24
140½	Prospect st., Medina	Highway	Lattice	W. I.	98.90	1	16.40	19.00	.....	.....	.....	.....	1885	100.43
141	Jackson's	Highway	Whipple truss	Wood	94.75	1	14.30	17.10	.....	.....	16	16 R.	1876	101.92
142	Sheiby's Basin	Highway	Lattice	W. I.	106.83	1	18.95	22.00	.....	.....	9	48 R.	1887	102.59
143	Town line	Highway	Whipple truss	W. I.	91.50	1	16.10	18.10	.....	.....	.....	.....	1898	103.33
144	Vernon st., Middleport	Highway	Whipple truss	W. I.	99.70	1	15.40	16.80	.....	.....	23	36 R.	1885	105.10
145	Main st., Middleport	Highway	Whipple arch	C. I. and W. I.	99.10	1	17.40	19.10	.....	5.00	23	12 R.	1856	105.18
146	Williams'	Highway	Lattice	W. I.	90.50	1	13.70	17.00	.....	.....	1	26 L.	1881	105.90
147	Watsons'	Highway	Whipple truss	Wood	90.40	1	14.63	17.50	.....	.....	8	32 R.	1887	106.70
148	Hurd's	Highway	Lattice	W. I.	93.00	1	14.50	17.50	.....	.....	12	20 R.	1881	108.26
149	Reynales' Basin	Highway	Whipple truss	Wood	106.80	1	15.44	17.00	.....	.....	16	16 L.	1897	108.55
150	Maybee's	Highway	Whipple arch	C. I. and W. I.	100.83	1	16.15	19.00	.....	.....	4	32 R.	1871	109.56
151	Gasport	Highway	Lattice	W. I.	97.80	1	16.35	19.00	.....	.....	10	22 R.	1885	110.47
152	Orangeport	Highway	Whipple arch	C. I. and W. I.	99.50	1	17.00	18.80	.....	3.80	18	53 R.	1871	111.49
153	Millard's	Highway	Whipple arch	C. I. and W. I.	99.40	1	16.80	19.04	.....	.....	0	34 L.	1857	113.47
154	Wakeman's	Highway	Whipple truss	Wood	97.30	1	11.00	14.80	.....	.....	.....	.....	1882	114.33
155	Young's	Highway	Whipple arch	C. I. and W. I.	98.55	1	16.30	19.00	.....	.....	.....	.....	1857	115.25
156	N. Y. C. & H. R. R. R.	Railroad	Lattice	W. I.	148.40	+	.....	16.00	.....	.....	43	00 L.	.....	115.86
157	Comstock's, Lockport	Highway	Whipple arch	C. I. and W. I.	102.90	1	16.20	19.00	.....	4.65	6.10	.....	1857	115.98
158	Adams st., Lockport	Highway	Whipple arch	C. I. and W. I.	102.70	1	14.85	17.00	.....	.....	.....	.....	1855	116.24
159	Chapel st., Lockport	Bridge fell down in 1898	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	116.35

* Tracks. † Track.

WESTERN DIVISION ERIE CANAL—Bridges—(Concluded).

Old number.	LOCAL NAME.	Use.	Style.	Material.	Clear span.	Number road-ways.	Clear width.	C. to C. trusses.	Number walks.	Clear width.	Skew.	When erected.	Miles from Wayne county line.
213	Ohio st., C. & S. canal L. V. R. R., C. & S. canal L. V. R. R., Ohio slip.	Highway Railroad Railroad	Bollman Plate girder Plate girder	C. I. and W. I. W. I. W. I.	55.70 58.50 60.15	2 *2 ...	16.20 11.00 11.40	19.40 14.00 14.40	2	6.65	Deg. Min. 19 40 R. ... 13 58 R. ... 2 32 R.	1868 1894 1871 1870 ... 1895	149.49 148.67 148.78 148.80 148.87 148.95 149.40
217	Perry st., Ohio slip	Highway	Lattice	W. I.	S. 58.0 N. 57.6	2	13.40	16.00	2	5.65	7.00	...	...
218	Fulton st., Ohio slip	Highway	Whipple arch	C. I. and W. I.	S. 60.5 N. 59.8	1	16.30	19.50	2	4.60	5.95	...	...
219	Elk st., Ohio slip	Highway	Bowstring	W. I.	58.75	2	15.55	18.35	2	7.20	7.80	1 00 R.	148.87
220	D. L. & W. R. R., Ohio slip. Ohio st., Ohio slip.	Railroad Highway	Pratt Plate girder swing	W. I. W. I.	63.90 51.80	... 1	13.50 16.85	15.00 19.50	1 1	4.20 4.83	5.00 5.54	... 1895	148.95 149.40
208	Main st.	Highway	2 lattice, 2 Whipple pipe, 2 Whipple arch	C. I. and W. I. W. I.	71.70 88.50 90.20	3 2 }	15.20 15.80 ...	20.30 19.20 42.20	2 2 2	14.00 7.90 6.00	18.75 12.20 7.00	1867 1873 1897	147.95 148.01 148.28
209	Washington st.	Highway	Lattice	W. I.	88.30	1	38.15	18.30	...	...	...	...	148.45
214	Michigan st.	Highway	Lattice	W. I.	51.23	*2	...	42.00	2	...	52 15 R.	...	148.45
215	N. Y. C. & H. R. R. R.	Railroad	Pony lattice	W. I.	88.80	1	38.20	17.00	2	...	...	1897	148.43
216	Chicago st. Louisiana st.	Highway Highway	Deck lattice girder Lattice	W. I. W. I.	90.10	2	14.60	...	2	5.90	7.10	1895	148.66

Bridges Over Hamburg Canal, Ceded to the City of Buffalo in 1897.

* Tracks.

Total number of bridges over canal and slip.....	274
Total number of bridges owned by the State.....	226
Total number of bridges owned by railroads.....	33
Total number of bridges owned by corporations.....	1
Total number of bridges owned by cities.....	11
Total number of Hamburg Canal bridges ceded to the city of Buffalo, Chap. 296, Laws of 1897.....	5

Materials in Construction State Bridges.

Steel and iron.....	168
Wood and iron.....	20
Wood.....	86
Abutments without bridge.....	1

Movable Bridges.

Lift.....	0	6
Lift (contemplated).....	2	0
Swing.....	2	0
Draw.....	1	0

State.

City.

[illegible]

Outside to outside.

Over all.

isix spana.

61.88, 59.80.

Track.

• Tracks.

WESTERN DIVISION ERIE CANAL—Bridges—(Concluded).

Old number.	LOCAL NAME.	Use.	Style.	Material.	Clear span.	Number road-ways.	Clear width.	C. to C. trusses.	Number walks.	Clear width.	Skew.	When erected.	Miles from Wayne county line.
213	Ohio st., C. & S. canal	Highway	Bollman	C. I. and W. I.	55.70	2	16.20	19.40	2	6.65	Deg. 19 40 R.	1868	149.49
	L. V. R. R., C. & S. canal	Railroad	Plate girder	W. I.	58.50	*2	11.00	14.00	...	...	...	...	...
	L. V. R. R., Ohio slip	Railroad	Plate girder	W. I.	60.15	...	11.40	14.40	...	...	13 58 R.	...	148.67
217	Perry st., Ohio slip	Highway	Lattice	W. I.	{ S. 58.0 N. 57.6 }	{ 2 2 }	13.40	16.00	2	5.65	2 32 R.	1894	148.78
218	Fulton st., Ohio slip	Highway	Whipple arch	C. I. and W. I.	{ N. 60.5 S. 59.8 }	{ 1 2 }	16.30	19.50	2	4.60	...	1871	148.80
219	Elk st., Ohio slip	Highway	Bowstring	W. I.	58.75	2	15.55	18.35	2	7.20	1 00 R.	1870	148.87
	D. L. & W. R. R., Ohio slip	Railroad	Pratt	W. I.	62.90	...	13.50	15.00	1	4.20	...	...	148.95
220	Ohio st., Ohio slip	Highway	Plate girder swing	W. I.	51.80	1	16.85	19.50	1	4.82	...	1895	149.40
Bridges Over Hamburg Canal, Ceded to the City of Buffalo in 1897.													
208	Main st.	Highway	2 lattice, 2 Whipple pipe, 2 Whipple arch	C. I. and W. I.	71.70	8	15.20	20.30	2	14.00	...	1867	147.95
209	Washington st.	Highway	Lattice	W. I.	88.50 90.20	{ 2 2 }	15.80	19.20	2	7.90	28 12 R.	1873	148.01
214	Michigan st.	Highway	Lattice	W. I.	88.30	1	38.15	42.20	2	6.00	...	1897	148.28
215	N. Y. C. & H. R. R. R.	Railroad	Pony lattice	W. I.	51.28	*2	...	13.80	...	...	52 15 R.	...	148.45
	Chicago st.	Highway	Deck lattice girder	W. I.	88.80	1	38.20	42.00	2	...	...	1897	148.48
216	Louisiana st.	Highway	Lattice	W. I.	90.10	2	14.60	17.00	2	5.90	0 6 L.	1885	148.66

* Tracks.

Total number of bridges over canal and slip	274
Total number of bridges owned by the State	225
Total number of bridges owned by railroads	32
Total number of bridges owned by corporations	1
Total number of bridges owned by cities	11
Total number of Hamburg Canal bridges ceded to the city of Buffalo, Chap. 285, Laws of 1897	5

Materials in Construction State Bridges.	
Steel and iron	168
Wood and iron	20
Wood	86
Abutments without bridge	1

Movable Bridges.	
Lift	6
Lift (contemplated)	2
Swing	2
Draw	1
State.	City.
6	6
2	0
2	0
1	0

BENCH MARKS.

No.	Miles from Wayne county line.	Elevation above old C. B.	Elevation above tide water.	Condition.	Description.
1	0.00	+11.904	+398.978	Gone.....	of buttress. Marked ().
2	1.69	11.905	398.938	Bad.....	buttress. Marked ().
3	4.03	12.040	397.114	Fair.....	ing buttress. Marked ().
4	6.47	.....	398.420	Good.....	ng. Marked (). Column
5	7.71	13.960	399.034	Gone.....	
6	7.89	11.696	401.635	Gone.....	
7	8.76	11.633	401.462	Good.....	
8	9.56	12.434	402.282	Gone.....	
9	10.15	4.072	393.851	Good.....	
10	10.32	9.188	398.917	Good.....	
11	10.58	4.001	393.830	Good.....	
12	10.90	16.451	406.280	Good.....	
13	11.28	11.537	408.726	Good.....	
14	11.76	12.409	408.598	Good.....	
15	12.44	11.657	408.846	Good.....	
16	13.79	11.520	408.709	Good.....	
17	13.10	11.448	408.637	Good.....	
18	13.38	6.234	402.423	Good.....	
19	13.95	12.269	409.458	Good.....	
20	14.13	10.354	407.543	Good.....	
21	14.24	14.925	412.114	Good.....	
22	14.68	9.111	412.551	Good.....	
23	15.48	12.241	415.681	Bad.....	
24	15.87	13.111	416.551	Good.....	
25	15.91	18.975	422.415	Good.....	
26	16.44	8.865	416.953	Bad.....	
27	16.93	11.538	424.876	Good.....	
28	17.17	9.444	416.782	Good.....	
29	17.81	11.336	424.624	Good.....	
30	18.01	12.230	435.518	Good.....	
31	18.57	4.230	417.508	Good.....	
32	19.10	16.525	429.813	Good.....	
33	19.31	16.855	438.171	Good.....	
34	19.45	16.728	448.043	Good.....	
35	19.93	10.262	447.584	Good.....	
36	20.06	11.077	448.399	Gone.....	
37	20.31	9.100	446.422	Gone.....	
38	21.20	11.764	449.086	Good.....	

Map. Marked ().

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Marked ().

Marked ().
Marked ().
d ().

BENCH MARKS—(Continued).

No.	Miles from Wayne county line.	Elevation above old C. B.	Elevation above tide water.	Condition.	Description.
39	21.80	11.231	448.553	Good	Peck's Br. No. 27, T. P. on W. wing. Marked [].
40	22.49	+12.010	449.332	Gone	Swezey's Farm Br. No. 28, T. P. on W. wing. Marked [].
41	22.94	11.625	448.947	Good	Palmer's Farm Br. No. 29, T. P. E. wing. Marked [].
42	23.46	11.420	448.743	Good	Port Gibson Br. No. 30, T. P. W. wing on third lower step. Marked [].
43	26.02	11.896	449.218	Good	Galloway's Highway Br. No. 31, T. P. E. wing on lower step. Marked [].
44	26.56	3.078	434.244	Gone	Culvert T. P. on center of parapet. Marked [].
45	28.29	+13.560	450.882	Good	Railroad Av. Br. No. 32, Palmyra, berme on W. wing. Marked [].
46	28.80	9.941	447.263	Good	Church St. Br. No. 34, Palmyra, T. P. on E. wing, lower step. Marked [].
47	29.49	10.9.4	448.256	Good	Change Br. No. 35, T. P. E. wing on N. side. Marked [].
48	29.67	8.926	446.248	Good	Mud creek aqueduct, T. P. E. abut., W. wing on buttress. Marked [].
49	30.09	12.339	449.661	Good	Crandall's Highway Br. No. 36, T. P. on E. wing. Marked [].
50	30.43	12.690	450.012	Bad	Clark's Farm Br. No. 37, T. P. E. wing on lower step. Marked [].
51	31.28	+11.811	449.133	Good	White's Highway Br. No. 38, T. P. E. wing, on lower step. Marked [].
52	31.60	18.693	455.915	Good	Lock No. 60, Macedon, on E. berme hollow quoin. Marked [].
53	31.97	11.454	4.8.827	Gone	Change and Road Br. No. 39, N. side on E. wing. Marked [].
54	32.39	15.683	463.056	Good	Upper Macedon Lock No. 61 on E. berme hollow quoin. Marked [].
55	32.54	.....	.....	Good	Macedon Highway Br. No. 40, T. P. W. wing by lower broken step. Marked [].
56	33.55	11.546	465.520	Good	Frear's Highway Br. No. 41, T. P. on W. wing. Marked [].
57	35.70	.....	465.893	Good	Wayneport Highway Br. No. 42, T. P. on W. wing. Marked [].
58	38.03	13.055	467.029	Good	Knappsville Highway Br. No. 43, T. P. on E. wing. Marked [].
59	39.03	.....	.....	Gone	Thomas creek culvert, T. P. on center of parapet coping. Marked [].
60	39.70	13.034	467.008	Good	Bakers Br. No. 44, T. P. on E. wing. Marked [].
61	40.01	11.741	465.718	Good	Waste-weir T. P. on E. parapet wall. Marked [].
62	40.32	12.458	466.432	Gone	Main St. Br. No. 46, Fairport, T. P. on W. wing. Marked [].
63	41.30	11.525	465.499	Good	Fullman Basin Br. No. 47, T. P. on E. wing. Marked [].
64	42.75	.....	.....	Gone	Culvert T. P. on N. W. corner of parapet. Marked [].
65	42.83	+10.154	464.128	Good	Wapping's Br. No. 48, T. P. on E. wing. Marked [].
66	43.17	11.430	465.404	Fair	Wiltzie's Farm Br. No. 49, berme, on E. wing. Marked [].
67	43.98	10.176	464.150	Good	Stopgate, T. P. on E. end, recess coping. Marked [].
68	44.28	.....	464.808	Gone	Bushnell's Basin Br. No. 50, T. P. on E. wing. Marked [].
69	45.87	12.000	465.820	Good	Cartersville Br. No. 51, T. P. on W. wing. Marked [].
70	46.03	.....	.....	Gone	Cartersville water weir T. P. on W. abutment. Marked [].
71	46.51	13.551	467.525	Good	Gtherney's Br. No. 52, T. P. W. wing on lower step. Marked [].
72	47.02	12.661	466.035	Good	Highway Br. No. 53, Pittsford, T. P. on E. wing. Marked [].
73	47.31	12.021	465.905	Good	Main St. Br. No. 54, Pittsford, T. P. on E. wing. Marked [].
74	47.76	11.868	465.842	Good	Sutherland's Br. No. 55, State Road, T. P. on E. wing. Marked [].
75	49.28	11.696	465.670	Good	Cooks' Highway Br. No. 56, T. P. on E. wing. Marked [].
76	49.57	17.922	471.696	Good	Lock No. 62, Pittsford, on E. berme, hollow quoin. Marked [].
77	50.05	10.879	474.008	Good	Weeds Br. No. 57, T. P. on E. wing. Marked [].

78	60.54	12.427	475.531	Good	Billingshurst Br. No. 58. T. P. on E. wing. Marked [].
79	60.79		471.207	Good	Waste well, borne on W. wing. Marked [].
80	61.34	12.246	475.473	Good	Donnelly's Br. No. 59. T. P. on E. wing. Marked [].
81	62.02	12.300	475.424	Good	Drake Br. No. 60. T. P. on E. wing. Marked []
82	62.41	17.730	480.854	Good	Miller's Lock No. 58. T. P. on E. wing. Marked [].
83	62.64		481.275	Good	Brighton Br. No. 61. T. P. on E. wing. Marked [].
84	62.93	18.907	490.413	Good	Stipple's Lock No. 64. T. P. on E. wing. Marked [].
85	63.33	18.904	500.878	Good	Lock No. 65 (2nd E. of
86	63.67		504.846	Good	Univer St. Br. No. 61. T. P. on E. wing. Marked [].
87	64.39	18.681	510.197	Good	Lock No. 66 (1st E. of Rochester), on E. borne hollow quoin. Marked [].
88	64.67	13.018	513.175	Good	Goodman St. Br. No. 64. T. P. on E. wing. Marked [].
89	65.03		513.018	Good	Averill Av. Br. No. 66. T. P. on E. wing. Marked [].
90	65.53		512.443	Good	Alexander St. Br. No. 67. T. P. on E. wing. Marked [].
91	65.68		509.778	Good	Griffith St. Br. No. 69. T. P. on E. wing. Marked [].
92	66.00	9.595	508.812	Good	Weightlock, east end of pier, near unubbing post. Marked [].
93	66.52	12.830	512.574	Good	at end of abut. on third step. Marked [].
94	67.41		508.839	Good	at end of abut. on third step. Marked [].
95	68.23	8.805	512.414	Good	at end of abut. on third step. Marked [].
96	68.78		511.718	Good	at end of abut. on third step. Marked [].
97	68.97	11.347	512.903	Good	at end of abut. on third step. Marked [].
98	69.58	12.595	513.723	Good	at end of abut. on third step. Marked [].
99	69.13	12.303	513.505	Good	at end of abut. on third step. Marked [].
100	69.10	12.083	513.755	Good	at end of abut. on third step. Marked [].
101	69.87	13.231	512.063	Good	at end of abut. on third step. Marked [].
102	69.90	11.610	502.175	Good	at end of abut. on third step. Marked [].
103	69.40	+1.617	513.329	Good	at end of abut. on third step. Marked [].
104	69.93	12.740	513.943	Good	at end of abut. on third step. Marked [].
105	69.06	13.292	501.992	Poor	at end of abut. on third step. Marked [].
106	69.58	0.413	512.732	Good	at end of abut. on third step. Marked [].
107	69.13	12.028	512.809	Good	at end of abut. on third step. Marked [].
108	67.03	12.131	509.846	Good	at end of abut. on third step. Marked [].
109	67.99	9.086	501.911	Fair	at end of abut. on third step. Marked [].
110	67.45	1.143	513.094	Good	at end of abut. on third step. Marked [].
111	67.79	12.312	514.270	Good	at end of abut. on third step. Marked [].
112	68.30	0.172	512.762	Good	at end of abut. on third step. Marked [].
113	68.80	+13.435	513.689	Good	at end of abut. on third step. Marked [].
114	69.15	11.913	513.319	Good	at end of abut. on third step. Marked [].
115	70.18	12.791	502.150	Good	at end of abut. on third step. Marked [].
116	70.52	12.405	509.545	Good	at end of abut. on third step. Marked [].
117	70.72	1.225	514.720	Good	at end of abut. on third step. Marked [].
118	71.43	8.582	507.847	Fair	at end of abut. on third step. Marked [].
119	71.59	18.764	512.245	Good	at end of abut. on third step. Marked [].
120	72.03	6.859	513.946	Good	at end of abut. on third step. Marked [].
121	72.64	11.262	508.416	Fair	at end of abut. on third step. Marked [].
122	72.96	13.913	502.009	Bad	at end of abut. on third step. Marked [].
123	73.96	5.366	511.113	Good	at end of abut. on third step. Marked [].
124	74.85	0.972			at end of abut. on third step. Marked [].
125	75.07	9.771			at end of abut. on third step. Marked [].

in. Marked [].

hollow quoin Marked [].

quoin. Marked [].

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Marked [].

Marked [].

BENCH MARKS—(Continued).

No.	Miles from Wayne county line.	Elevation above old U. S.	Elevation above tide water	Condition.	Description.
126	75.55	11.816	512.971	Good	Smith St. Br. No. 102, Brookport, T. P., E. wing, on lower step. Marked [].
127	75.54	9.182	510.838	Good	Brookport wastewdr, E. abut. on E. pier. Marked [].
128	75.54	2.068	503.807	Bad	Dive culvert T. P. on parapet. Marked [].
129	75.13	9.949	511.128	Good	
130	75.38	0.753	502.197	Bad	
131	79.26	8.973	510.307	Good	
132	79.31	14.597	515.934	Good	
133	79.44	10.291	511.634	Good	
134	79.44	10.339	511.686	Good	
135	79.78	13.759	515.118	Good	
136	80.02	1.484	502.836	Fair	
137	80.45	14.011	515.402	Good	
138	81.06	3.408	498.016	Good	
139	81.29	+14.253	515.675	Good	
140	81.49	11.025	512.496	Good	
141	81.78	14.262	515.728	Good	
142	82.48	4.398	505.989	Good	
143	82.85	13.303	514.315	Good	
144	84.01	1.364	502.894	Fair	
145	84.20	10.391	511.953	Good	
146	84.20	14.297	515.868	Good	
147	84.96	14.503	516.110	Good	
148	85.00	0.950	502.623	Corroded	
149	86.48	14.647	516.327	Good	
150	87.01	1.386	503.965	Good	
151	87.19	+13.456	515.170	Good	
152	87.96	1.142	502.893	Good	
153	88.68	14.323	516.198	Good	
154	88.94	10.413	512.211	Good	
155	89.29	11.142	512.967	Good	
156	89.46	7.890	509.753	Good	
157	89.96	4.808	506.640	Good	
158	90.55	13.802	515.777	Good	
159	90.83	4.982	506.823	Good	
160	91.17	23.116	516.920	Good	
161	91.17	5.508	507.412	Bad	
162	93.41	13.016	514.895	Good	
163	93.72	14.143	516.145	Good	
164	93.10			Good	

Eagle Harbor Br. No. 131, T. P., E. wing on lower step. Marked [].
 Starkweather's farm Br. No. 132, T. P. on E. wing. Marked [].

Allen's Br. No 124, T. P. on E. wing.	Long's Br. No. 124, T. P. on E. wing.	Marked {}.
165	56.47	Good
166	56.56	Good
167	56.15	Good
168	56.78	Good
169	.....	Good
170	57.52	Good
171	.....	Good
172	58.15	Good
173	58.94	Good
174	59.58	Good
175	59.82	Good
176	59.82	Good
177	59.82	Good
178	59.95	Good
179	100.43	Good
180	.....	Good
181	101.10	Good
182	101.91	Good
183	102.59	Good
184	103.33	Good
185	.....	Good
186	104.58	Good
187	105.18	Good
188	105.85	Good
189	105.88	Good
190	106.70	Good
191	106.90	Good
192	106.26	Good
193	106.85	Good
194	106.69	Good
195	110.52	Good
196	111.98	Good
197	113.47	Good
198	114.48	Good
199	114.96	Good
200	115.98	Good
201	118.24	Good
202	119.44	Good
203	118.48	Good
204	116.92	Good
205	117.01	Good
206	.....	Good
207	119.65	Good
208	121.02	Good
209	122.22	Good
210	.....	Good
211	123.74	Good
212	126.63	Good
213	135.65	Good

BENCH MARKS—(Concluded).

No.	Miles from Wayne county line.	Elevation above old C. B.	Elevation above tide water.	Condition.	Description.
214	125.42	14.131	574.208	Good	Tonawanda dam on N. E. cor. of masonry. Marked [].
215	125.84	17.087	578.194	Good	Tonawanda, T. P. on W. wing. Marked [].
216	128.11	17.225	577.017	Good	No. 189, T. P. on E. wing. Marked [].
217	128.19	16.030	576.504	Good	P. W. wing on third course. Marked [].
218	141.09	15.416	576.012	Good	Grand Island Ferry Br. (Scott's), No. 188, T. P., W. wing, second course. Marked [].
219	143.09	16.533	577.820	Good	Herk Co. Br. No. 189, Black Rock, berm abutment on W. end. Not marked.
220	143.38	16.082	575.868	Good	Black Rock Guard Lock No. side on W. hollow quoin. Marked [].
221	143.36	14.871	575.677	Good	Black Rock Guard Lock, S. side on W. hollow quoin, E. end. Marked [].
222	143.42	16.140	579.371	Good	Hamilton St. Br. No. 190, Black Rock, S. abutment S. W. wing, iron bolt in second coping stone. Marked [].
223	143.55	15.412	578.643	Good	Amherst St. Br. No. 191, Black Rock, T. P. abutment, W. wing, fourth stone from bottom. Marked [].
224	143.66	16.000	578.231	Good	Mill St. Br. No. 192, P. abutment, E. wing on bottom step. Marked [].
225	.....	15.404	578.695	Good	Manning's malt house, E. end, fourth window sill from end. Not marked.
226	144.91	15.196	579.427	Good	Ferry St. Br. No. 194, berm abutment, E. end on step. Marked [].
227	.....	15.495	578.726	Good	Engine room to water works, W. end of building, door sill on N. end. Not marked.
228	.....	26.538	589.769	Fair	N. Y. C. R. R. Br., T. P. abutment, E. end. Marked [].
229	146.39	25.423	588.651	Good	York St. Br. No. 195, N. abut., W. wing, first stone below coping on N. W. corner. Marked [].
230	147.08	19.608	592.839	Covered	Georgia St. Br. No. 197, T. P. abut., N. W. wing. Marked [].
231	147.43	16.287	579.519	Good	N. Y. C. R. R. Br. N. abut., W. end, on lowest step. Marked [].
232	147.37	17.842	581.073	Good	Genesee St. Br. No. 200, N. abut., W. end, fourth step from bottom. Marked [].
233	.....	13.090	576.821	Good	Howe House W. of Erie St., W. end, third door sill. Not marked.
234	147.86	14.213	577.505	Good	Commercial St. Br. No. 203, S. abut., E. end, on lowest step. Marked [].
235	147.95	25.204	588.435	Good	Main St. Br. No. 204, Hamburg canal, N. abut., W. end, E. end of coping, outside of railing. Marked [].
236	147.95	14.459	577.690	Good	Main St. Br. No. 208, Hamburg canal, N. abut., W. wing, on lowest step. Marked [].
237	148.42	18.103	581.274	Good	Perry St. Br. No. 211, Clark & Skinner canal, E. abut., N. wing. Marked [].
238	148.98	21.476	584.707	Good	Elk St. Br. No. 212, Clark & Skinner canal, E. abut., N. end. Marked [].
239	148.49	21.177	584.408	Good	Ohio St. Br. No. 213, Clark & Skinner canal, E. abut., N. end. Marked [].
240	148.23	22.310	585.741	Good	Scott St. Br. No. 210, Clark & Skinner canal, E. abut., N. end, on second coping stone. Marked [].
241	148.28	24.316	587.546	Good	Michigan St. Br. No. 214, Hamburg canal, N. abut., N. R. end, third coping stone outside of rail. Marked [].
242	148.48	23.025	586.356	Good	Chicago St. Br. No. 215, Hamburg canal, S. abut., on W. end. Marked [].
243	148.66	23.439	586.670	Good	Louisiana St. Br. No. 216, Hamburg canal, S. abut., W. end. Marked [].
244	148.68	23.128	586.357	Good	Louisiana St. Br. No. 216, Hamburg canal, N. abut., E. wing. Not marked.
245	148.73	24.419	587.650	Good	Perry St. Br. No. 217, Ohio slip, E. abut., N. end. Marked [].

APPENDIX No. 1.

APPENDIX No. I.

OFFICE OF THE STATE ENGINEER AND SURVEYOR,
ALBANY, N. Y., *September 12, 1898.*

HON. FRANK S. BLACK, *Governor:*

DEAR SIR.—After carefully reading the report of the Canal Investigating Commission appointed by you, pursuant to chapter 15 of the Laws of 1898, it seems certain that my duty toward myself and the employes of this Department demands some statement on my part concerning certain features of this report which are cruelly unjust, unfair and unwarranted under the circumstances.

The truth of the adage that “circumstances alter cases” is beyond question, and, therefore, it is imperative that the attendant circumstances connected with the inception and prosecution of this improvement work should be given due weight with the bare facts before a proper conclusion can be reached.

A large part of the unfairness of the report in question consists in the almost total exclusion of that “other side” without which no story is complete.

Too many of the statements are made after the manner of half truths so as to lead to unwarranted inferences, and this sort of accusation by innuendo so dominates the report as to leave no doubt about the studied effort to suppress practically everything favorable to the management of the work.

Some of the criticisms are, however, based on a misunderstanding by the Commissioners; if that is not the case, then they have deliberately misstated the facts. The end of all this in the public mind is the same in either case and can not be tolerated without protest by those in a position to appreciate its viciousness. A goodly share of the criticism which has followed the canal officials always, and especially since the inception of this

work is due solely to the newspapers, and the one-sided, unexplained statements of the reports in question have afforded the partisan press an opportunity to magnify the criticisms into all sorts of monstrous charges, which, however, are not borne out by a careful reading of the reports. But the public reads the papers and not the reports, and if, as some of the Commissioners now state, the report has not been properly received, the fault is still theirs for making their criticisms and statements in such an indefinite and general manner as to make it possible for the press to misconstrue or misinterpret the real meaning and intent of the reports.

It is now hoped that the hysterical period connected with this work has been outlived, and that a period of sober second thought may ensue, to the lasting benefit of the State's canals and their future officials. If what follows herein shall conduce to that end, the effort toward its compilation will have been well spent.

A fair understanding of the situation demands that each step in the work be considered from the beginning.

FUNDS FOR SURVEYS.

For a number of years preceding the beginning of this work, there had been quite a sentiment developing for some radical improvement, at least to the Erie canal, and a number of schemes had been proposed. The data available for a fair understanding of the features of any of these proposed plans were so meagre as to be practically useless, and for that reason efforts had been made for a number of years in our State Legislature to obtain money for making the necessary surveys, and similar efforts were also made in Congress by those interested in the so-called "Deep Waterways" scheme. However, until this work was authorized, no funds had been available for an intelligent survey and estimate of cost of any of the schemes proposed.

REPORTS TO CONSTITUTIONAL CONVENTION.

It therefore followed that when the Constitutional Convention of 1894 assembled and asked the State Engineer and Superintendent of Public Works for estimates of the cost of making

various improvements to the several canals, both officials were compelled to reply in substance that they had no data to work on, and that their estimates should, therefore, be considered only as rough approximations based on such general knowledge as would naturally be acquired in connection with other work on the canal system. The present officials have been subjected to all sorts of unfair criticisms by the newspaper press on the score of these estimates, and they usually fail to state the facts as contained in the reports of those officials to the Constitutional Convention. These reports are printed in the proceedings of the Constitutional Convention, and can be inspected by anyone who wishes to verify these statements.

Only twelve days were spent in the preparation of the resulting estimates.

Fortunately at that time it so happened that ex-State Engineer Martin Schenck was then employed in the Department of Public Works on special work. This connection enabled the Superintendent of Public Works (then Mr. Edward Hannan) to avail himself of Mr. Schenck's professional ability and familiarity with the canals to help him in the preparation of his report. That report will show the Superintendent's estimate of the cost of the improvement authorized, to be \$9,456,000, but on reading the report, it will also be apparent that the author's idea was that the deepening of the prism and raising of the banks could be accomplished without any extensive work in connection with the walls, for he says:

"These estimates are based upon the theory that there would be one foot excavated from the bottom of the canal, and one foot of embankment placed on top of the bank, and the excavation so made as not to trip nor disturb existing slope or vertical walls."

The estimate of this Department for the work authorized was \$11,573,000, in addition to which it was stated that a million dollars could be used to good advantage in repairing and rebuilding the vertical walls.

To appreciate the unfairness of the question asked by the Convention, and the unreliability of any estimates made under such

conditions, one has but to remember that the work authorized covers 454 miles, through the most thickly-settled portion of this State, embracing an endless number of obstacles and difficulties, many of which, as has since been proven, could only be discovered as the work progressed.

LEGISLATION FOR IMPROVEMENT WORK.

Notwithstanding the sums named in these estimates, the Legislature saw fit to reduce the amount to be asked for to \$9,000,000. That action was taken without the advice of either canal department, the Commission's statement (p. 143) to the contrary notwithstanding. The reason for it as now understood was that that sum was believed to be all that the people would authorize for the improvement in question, at least at one time.

The Convention prepared a separate amendment to the Constitution authorizing the Legislature to provide for the improvement of the canals, which was voted upon in 1894, and received a majority of 115,000 — 32,000 larger than that given for any other amendment.

Governor Morton urged the Legislature of 1895 to carry into execution the wishes of the people in this respect, and this was done by the passage of chapter 79 of the Laws of 1895. Strange as it may seem this law charging this Department with such enormous responsibilities was never submitted to this Department prior to its passage.

This bill was again ratified by the people in 1895, by the enormous majority of 276,000 votes. The essential features of the law are contained in section 3, which says:

“Within three months after issuing of the said bonds the Superintendent of Public Works is hereby directed to proceed to enlarge and improve the Erie canal, the Champlain canal and the Oswego canal; the said improvement to the Erie and Oswego canals shall consist of deepening the same to a depth of not less than nine feet of water except over and across aqueducts, mitre sills, culverts and other permanent structures, where the depth of water shall be at least eight feet, but the deepening may be

performed by raising the banks wherever the same may be practicable; also the lengthening or improving of the locks which now remain to be lengthened, and providing the necessary machinery for drawing boats into the improved locks and for building vertical stone walls, where in the opinion of the State Engineer and Surveyor and Superintendent of Public Works it may be necessary. The improvement upon the Champlain canal shall consist in deepening the said canal to seven feet of water, and the building of such vertical stone walls as in the opinion of the State Engineer and Surveyor and Superintendent of Public Works may be necessary. The work called for by this act shall be done in accordance with plans, specifications and estimates prepared and approved by the State Engineer and Surveyor."

It will be well to bear in mind the wording of this section in considering the report of the Investigating Commission, for they have deliberately misstated its provisions in one section of the report wherein they say (see page 12) that the contemplated improvement did not embrace the Lockport and Cohoes locks (see also pages 38 and 39). That misstatement on their part forms the basis of charging this Department with the improper expenditure of \$49,391.32, though on page 22 of the Engineer's report, they recommend that a barge lift be tried at Lockport, Cohoes, Newark or Little Falls, preferably Newark. This is exactly what we planned to do, and why it was improper, since they still recommend it, is not clear. This, however, will be considered later.

PRELIMINARY SURVEYS AND ESTIMATES.

As soon as the results of the election of 1895 were known, and it became certain that the canals were to be improved as provided in this law, this Department began to prepare for the work. Conceiving it to be our duty to start as expeditiously as possible, we notified the Civil Service Commission on November 23, 1895, that we would need thirty assistant engineers, fifty levelers, thirty rodmen, and from 100 to 150 chainmen. On January 2, 1896, we were notified by the Civil Service Commission of the names on the eligible list, and on January 13, 1896, the entire number was ap-

pointed, but we still lacked over 100 men to complete the full complement in all the parties, and the Civil Service Commission was again notified that we would need this additional number of men. The second eligible list, however, was not available until February 28, 1896, and this delay seriously hampered the Department in the execution of its plans, which aimed at a thorough survey and careful estimate of cost of the whole work, before any of the contracts were awarded, to the end that each step might thereafter be taken intelligently.

It was believed that the field work connected with the preliminary surveys and estimates could be completed by the opening of navigation, May 1, 1896, and that the office work thereon would progress with such speed as to place all the information in our hands early in the summer of 1896, so that some contracts could be awarded early enough to give the contractors ample opportunity to provide the materials needed for the winter's work, and equip themselves thoroughly for the work in hand. On this basis the Comptroller was told that the preliminary work would cost about \$40,000 per month for three or four months. The cost per month was about as stated, but the time was largely exceeded. This estimate was based solely on the judgment and work theretofore done by the more experienced engineers then employed, but it was found in practice that many of the new appointees had had comparatively little experience and that they could not progress their work at the rate of speed expected of them. As the law prevented the selection of engineers of known skill and ability, and confined the appointments to the competitive civil service lists, there was no alternative but to proceed and do the best that could be done under the circumstances. Barring the one feature of experience, and that does not apply to all the men, they were unquestionably equal in personnel to any corps of equal size ever organized, and in this the Commission agrees. That there would be some weak spots in such a force was reasonable to expect and that they would leave their impress on the work was equally to be expected.

The law prescribes that such cases can only be cured by the

substitution of equally untried and unknown men and bars the appointment of men of known attainments.

The preliminary work consumed considerably more time than was expected by reason of inexperience in certain cases and because of exceptionally severe weather and of hitherto unseen difficulties which were encountered and had to be met as they arose. The Commissioners say that the surveys failed of their purpose because they were not pursued far enough. We also appreciate that more time could have been spent on them to good advantage, but as our expenditures were exceeding our estimates, and had already reached a goodly figure, without any actual work having been done, the various canal organizations, boatmen and shippers, the Comptroller and the newspaper press generally, were criticising not only our expenditures but our failure to actually start some of the construction work. All manner of charges of delays, extravagance and incompetence were afloat, for the reasons stated, and the difficulties under which we labored on this account can not be overestimated. The force of the arguments used seemed apparent to every one not directly responsible for the work, and in deference to popular prejudice and opinion, our forces were finally reduced when they should have been kept at work, pursuing their researches, perfecting plans and estimates, and generally preparing for the work in hand.

The Commissioners and their engineers find much to criticise in these preliminary surveys and in the preparation of the specifications to govern the work. It is, therefore, essential in order to discuss these criticisms intelligently that the circumstances attending the work be set forth here briefly, though the subject will be enlarged upon in numerous places throughout this statement when individual criticisms are discussed.

The direction of all parties in the field was confided to the supervision of the duly appointed division and resident engineers, and next in authority under them, of the first assistant engineers, every one of whom was familiar with similar work done on the canals, having served in various capacities in this Department for periods varying from three to over thirty years.

The estimates for the completion of the greater portion of the work were not available until late in the fall of 1896, and detailed estimates of the cost of each and every contract were not available until November, 1897, at which time the information was given to the public in the shape of a long letter to the so-called Executive Canal Committee, representing the Chambers of Commerce and Boards of Trade of the principal towns and cities of the State. This committee was responsible for the preparation of the improvement law and the fixing of the appropriation therefor at \$9,000,000. In that decision the canal officials had no part whatever. The charge has repeatedly been made that the information afforded by the 1896 estimate was purposely suppressed. That is not true. Those estimates, which by the way were not complete, indicated that the cost of the work would be in the neighborhood of \$15,000,000,—not \$13,500,000 as the Commission states. It was believed at the time that a great deal of work was included in these estimates, which, though badly needed, could possibly be held for future appropriations. The estimates were, therefore, returned to the division engineers with instructions to eliminate therefrom everything which could in their judgment be so held, or which by any process could be avoided. It was hoped that this process would reduce the total estimate to \$9,000,000 or less. The Commissioners' statement that the State Engineer directed the cutting out of arbitrary quantities toward this end is absolutely untrue. It was expected and requested simply and only that the division, resident and assistant engineers would go over their work again, examine it with great care, consult the State Engineer when necessary, and eliminate every unnecessary item or quantity.

This was done and the effort was a conscientious one, and though it failed, it has never yet been shown how the State or any one suffered thereby except in disappointment. Any business man undertaking the same work individually would have pursued exactly the same course. When a man starts to build a house, for instance, and finds, after completing his plans, that the estimate of cost is far greater than he expected, or exceeds the sum he had

available for the work, does he usually wait until he has earned more money or does he modify his plans? Perhaps it would have been better to have told the people through the newspapers that the 1896 estimate indicated that \$9,000,000 would not suffice for the work. It probably would not have accomplished any useful purpose whatever, and moreover it was honestly believed at that time that the cost would be reduced to \$9,000,000. |

Suppose the canal officials had given up because the first estimates indicated that \$9,000,000 would not suffice? Would they have been commended by either the friends or the enemies of the canals? Not much. Charges of trying to secure more money and greater patronage for the party, and of trying to defer any improvement to the canals in the interests of the railroads and other equally ridiculous statements would then have appeared in the press. It is a case of being "damned if you do and damned if you don't."

The law was mandatory and we proceeded. In less than two years the Commission agrees that about 173 miles have been completed and that the work is better than that heretofore done on the canals. Three hundred of the 454 miles have been put under contract and the work is well advanced. The proportion of work done as stated by the Commission is somewhat too low, but the exact amounts are difficult to determine, from the nature of the work. We were not in a position of being charged with the duty of ascertaining whether or not \$9,000,000 would suffice for the work, but were directed to proceed with the improvement with the funds available. Moreover the law was equally mandatory as to each of the canals, and though an effort was once made to concentrate the work on the Erie canal, a knowledge of that fact soon reached the friends of the Oswego and Champlain canals and the protests and discussions that followed clearly indicated that without the aid of the votes from the counties through which the two latter canals pass it would be impossible ever again to secure a further appropriation for completing the work. Such a result seemed inevitable if that course were adopted, and as that would have been a public calamity, and as the law entitled these two canals to part of the

improvement work, we believe we did the best, most expedient and proper thing, under all the circumstances, by apportioning the work to the worst spots on all three canals, while continuity has not been lost sight of.

The canals were known to be in an extremely dilapidated condition. The Investigating Commission clinches this fact by stating that without the expenditure of greater sums than had heretofore been available for repairs and improvements the canals would have been effectually closed in ten years.

It was known that because of the existing condition of the canals the traffic thereon was constantly diminishing and that the canals did not, therefore, constitute as important a factor toward our material welfare as they should. It will also be recalled that the time during the inception of this work was one of great commercial stagnation. Thousands of people in all the larger centers of population were idle and were being maintained by charity.

These three conditions were carefully considered and it seemed certain that each of them would be materially relieved by inaugurating the improvement work promptly and prosecuting it with all possible dispatch. The Commission seemed to think that this was all wrong, and say that the work was started in "undue haste."

THE SPECIFICATIONS.

It is true that at the time the surveys were being made and during the preparation of part of the estimates no specifications governing the work had yet been prepared, but each of these men knew substantially what would be required, and since the present specifications are based largely on former precedents of the Department, there seemed no reason why any misunderstanding should arise as to what materials were to be paid for and how, and even though such a misunderstanding should occur, the specifications were finally prepared, of course, before any contracts were awarded, and it was believed that all features appearing in the bidding sheets had been arranged to conform to the specifications.

During the summer of 1896 each of the division engineers was asked to submit a specification covering his views for the work on his division, but applicable as far as possible within his knowledge to similar work on the other divisions. These were duly submitted, but for obvious reasons no one of them was found complete, sufficient or desirable in itself. A specification was then prepared embodying certain features of each of those submitted, which was believed to be sufficient to cover any and all work that might have to be done. The general plan of these specifications consisted in making the first page thereof applicable to and specially descriptive of the particular work to be done upon any given contract. The succeeding pages thereof were used as a standard for all the work, it being deemed by all the engineers to be of vital importance that one specification should, as far as possible, govern the entire work so as to avoid a multitude of conflicting opinions and orders which would naturally result from a variety of specifications for similar work. When the first copy of these specifications was ready a conference was called for at the Albany office. At this conference were present State Engineer and Surveyor Adams, Deputy State Engineer Roberts, Division Engineers Smith, Gere and Little, Resident Engineers Himes and Morris and Assistant Engineers Leutze and Kaley of the Eastern Division, Driscoll and Whitford of the Middle Division, and Wilbur of the Western Division. Some of these men have had over thirty years' experience on the canals, and except two or three all have had about ten years or more of this experience, in addition to previous experience on other work. It is fair to presume that these men were not devoid of judgment regarding work of this kind and the specifications to govern it. They are and were familiar with the reasons for some of the provisions, which, however, would not apply to work other than on the canals. They had seen the loopholes left open by former specifications, and such abuses as have been encountered year after year, and they were quite as well fitted by experience, education and every other requisite to decide about those matters intelligently as any lot of

men who could have been chosen for the work. You can always do a thing in more ways than one, but it does not follow that the second way is better than the first until the experiment has been tried.

ACTION OF FROST SINCE WORK BEGAN.

The fact that all of the estimates originally made have been largely increased does not necessarily indicate that poor judgment was used in their preparation. Too much work that should have been included, but which it was believed could be saved, was cut out of these estimates, but even aside from the difficulties which could not then be foreseen, and which have since added largely to the cost, it must not be forgotten that the old portions of the canals are not in the same condition to-day that they were when those estimates were made, by any means.

For the past three winters it has been absolutely necessary to have all of the water drawn off these three canals, thus exposing the banks, walls and structures to the destructive influence of frosts and storms. Usually the various levels have sufficient water left in them to protect these features.

No reasonable person can doubt that this exposure to the elements has been an enormous factor in the increase of cost. It has been apparent to all the employes of both Departments since the work began. The dilapidated condition of practically all of the walls and structures, in the rebuilding of which the great bulk of the cost is encountered, left them easily susceptible to the ruin which has resulted. The work, however, could not have proceeded, and neither could the surveys have been made without thus drawing off all the water.

This action of frost was clearly indicated last winter on the Champlain canal, where, on contract No. 10, a piece of the towing-path 300 feet long cracked off four feet back of the inner angle and extending down the canal bottom, and slid into the canal with the vertical wall, which was supposed to protect it.

Also on Champlain canal, contract No. 28, a similar break occurred in the towpath six feet back from the inner angle, and in this case 1,300 lineal feet of the towpath and its protecting slope

wall slid into the canal. No new work was done anywhere near this location, and no teaming had been done on the towing-path. Of course, there was nothing to do but to rebuild the work at a considerable cost.

In some places the withdrawal of the water, and consequently of its sustaining pressure on the banks and walls, has caused them to slide into the canal in large quantities. The work through Buffalo, where the canal had not been drained in over thirty years, and hence there conditions could not be foreseen, forms a notable example of this manner of increase.

Following the completion of the surveys and estimates, plans were prepared for awarding some of the contracts, and just here it is proper to say that all of the contracts thus far awarded have been for those portions of the canal embracing the greatest difficulties, because those very difficulties had been for years a hinderance to navigation.

CRITICISMS OF SPECIFICATIONS.

The Commissioners say, in their report, that their criticisms of the specifications are based on the report of their consulting and advisory engineers, and since the latter devotes considerable space to this subject we may fairly take up the criticisms as therein stated, without paying any particular attention to the same matter, as covered in the Commissioners' report. These criticisms in the engineers' report are embodied in pages 6 to 11, inclusive, and in order to take up each item specifically, it seems proper to quote those pages here, numbering each paragraph for reference in the following statement:

1. "This type of specification, with detailed classification, was, at one time, much in vogue in railway building. The contractor made up his bid from the center line profile, and might go on the ground to judge questions of transportation, material and supplies. In canal work he might, as shown in evidence, have the additional motive of determining errors and lapses in the quantity sheets, so as to be the lowest bidder and the highest on final estimates. The method by piecework and bills of material, with

force account for contingencies, is an early stage in the evolution of the contract from day labor practice.

“In the fact that close surveys for exact definition of the work were not required under this style of specification, and that such surveys were not made, we have great variations from the estimates, and extra work and changes of plans seem to have been the rule rather than the exception.”

1. The engineers suggest that this type of specification is somewhat antiquated. On the other hand it is believed that the great bulk of the public work in this country to-day is based on similar specifications, that is, a specification providing a separate rate of compensation for each of the units comprising the work, and it is still believed to be the best for this especial purpose for this reason—it does not ask either the State or the contractor to insure against conditions which can not be foreseen, and, on the contrary, it provides for what is supposed to be an equitable compensation for the actual amount of work done—no more and no less.

If the State asks the contractors to name a price for completed work to be done under risky conditions, as most of this work is done, the inevitable result would be higher prices. On the other hand, if the State asked for such prices and attempted to define the conditions in advance, and it was afterward found that those conditions developed otherwise than as stated, the contractor would surely claim additional allowance, and experience shows that the courts have and will allow such claims under such conditions whether the engineers do or not.

Moreover, if these conditions prove to be less arduous than as defined, experience shows that the State would be unable to effect any saving. It is a rule that does not work both ways. Except in very rare cases, the prices for the work under these specifications are too low. The Commission agrees that they “are as low as could reasonably be expected.” They also admit that the resulting work is superior to similar work heretofore done on the canals. Witness the paradox: Poor specifications produce good work at low prices!

It is impossible on some kinds of work to definitely determine the quantity of the work before it is done, and the conditions under which it is to be done, and for such work these specifications could be improved. Practically all of the work in question, however, is not embraced in this class, but the quantity and sometimes even the quality of the work to be done requires radical changes under the conditions as they develop. Nine of the final accounts thus far submitted are for sums substantially the same as or less than the engineers' estimates.

If it were attempted to determine the cost of all this work with absolute certainty, the cost of that determination would in many cases have been so excessive as to have formed just ground for adverse criticism. That has been shown repeatedly by years of experience in this canal work, to which sufficient weight has not been given in this investigation.

This whole feature of the specifications may reasonably be looked at in this manner, namely, that so long as the State gets value received for the money expended, it makes little difference whether the preliminary estimate was too low or too high. In other words, the final estimate shows what the original estimate should have been, but the cost and uncertainties connected with determining these quantities accurately in advance are avoided. An attempt at accuracy is always made, but it will be apparent why these are easily frustrated. It can readily be seen that on 454 miles of this kind of work on old, dilapidated canals, with thousands of structures, the physical condition of which could only be determined at great expense; with hundreds of miles of vertical and slope walls, every foot of which would have to be undermined from one to seven feet during the most dangerous season of the year when frosts, floods and storms were the constant rule, and with this work extending over sections of country in such manner as to embrace almost every known difficulty in prosecuting work of this kind; with the foot of the walls covered by many feet of frozen earth, besides snow and ice, at the time the surveys were made, thus almost completely preventing an accurate determination of conditions; with part of the

work, and that part in some of the most difficult portions, flooded with water that could not be removed, except at enormous cost, it can, I repeat, readily be seen by any fair-minded person that *this work must of necessity embrace a much larger percentage of uncertainties than almost any other kind of public work. It is in fact far more difficult to correctly estimate on in advance than a new canal of similar length would be. In the latter case all uncertainty as to the physical condition of walls and structures could be determined in advance.*

The great bulk of the cost is in connection with these walls and structures. The total excavation that has been done, covering about half of the whole work, and including the excavation for walls and structures, amounts in round figures to only \$2,000,000. In other words, seven-ninths of the cost is for walls, structures and supervision.

Many miles of the old so-called slope walls have, from years of neglect, become little better than a mess of loose stone or riprap, and the Commission's engineers have reported, and it is true, that much of the old vertical wall, in fact the greater portion, is simply a veneer facing, absolutely without bond and proper backing. Such wall looks good on its face, but its condition can only be determined by tearing down a piece of it, and even then its condition would only be known in that particular spot. Very few of either the vertical or slope walls extended down to old canal bottom, and practically every foot of both kinds of these walls was covered at the base with several feet of earth, in the form of an inverted arch, with the greatest deposits over the bottoms of walls, thus making a conclusion as to the character of the buried portion impossible except at a great expenditure of time and money for uncovering the same. This time and money has been saved and the walls rebuilt only when absolutely necessary, but thousands of test pits have been dug to show the conditions around foundation walls and structures.

To illustrate more forcibly why it is impossible to determine the quantity and sometimes the quality of the work in advance, with any degree of certainty, and without the expenditure of

vast sums of money for preliminary research, let us refer to Western Division Contract No. 1, which included the Erie canal through the city of Buffalo and four slips connecting same with Lake Erie. This section of the canal is part of the so-called Lake Level, and its water surface is the same as that of the lake, fluctuating with the latter to the extent of over five feet. This latter feature makes it necessary that the walls and banks should be unusually high so as to provide for these fluctuations.

This section could only be drained by the construction of expensive cofferdams and the maintenance of an enormous pumping plant constantly during the prosecution of the work. It had not been drained in over thirty years, during which time many buildings have been built close to its banks. Sewage and refuse of every description had during this time been accumulating in enormous quantities, and the work of the elements, aided by numerous other conditions, had been constantly tending to decrease the efficiency of all the walls and structures, which are numerous on this section.

The cost of draining this section was estimated at \$30,000, and it was done at a loss under this contract for \$28,200. The preliminary estimate was necessarily made with the water in the canal—only the tops of the walls could be seen, and the amount and character of the excavation could only be determined by soundings. The excavation varied in depth from two feet in the center of the canal to nine feet in front of the walls, notwithstanding that new canal bottom is only nine feet below the water surface as observed since this work was started. If there was any way by which the character of the walls and even the depth to which they extended could be determined prior to the starting of the work, we have yet to learn by what method it could be done.

A great many things had to be assumed; for instance, it seemed fair to believe that where the soundings indicated rock practically at the grade of old canal bottom, the vertical walls would be carried down to that rock for their foundation. Experience showed that several thousand feet of such walls on this contract were

carried down nearly to this rock, and was then founded on a single timber under the front line thereof, and with about one foot of earth intervening between this timber and the solid rock. Such construction can only be characterized as idiotic, but it was no fault of the present administration.

The conditions were there, and as they were uncovered they had to be met and overcome. It was found absolutely impossible to save large portions of the walls so built, and while the work was under way thousands of cubic yards slid into the canal, followed by the banks behind them, and there was no alternative but to rebuild them at great expense. These walls are from five to six feet higher than on any other portion of the canal, yet the cross-section of the walls in many places shows that notwithstanding this increased height they did not have the same width of base as has been found necessary for the ordinary height of wall.

The sliding of these pieces of wall has been followed by enormous quantities of material comprising the banks behind them, all of which had to be excavated and refilled. This sort of thing throughout the whole work has enormously increased the amount of excavation, and conclusively refutes the Commission's (or its counsel's) statement that if there was any single quantity that could have been determined accurately in advance it was that of excavation.

The excavation of that portion of this contract between the Commercial slip and the Exchange street bridge was almost entirely composed of sewage, in which it was found impossible to work either men or teams. After being once drained it was found necessary to flood it again and do the excavation with a dredge. Both banks along this entire distance are lined with brick buildings, some of which are of considerable size, and nearly all of which are barely off the "blue lines" or State property.

When the canal was drained and the water pressure taken away from the banks, the great weight of these buildings against the walls in the canal, which are from fourteen to sixteen feet away from the building lines, began to move toward the center of the

canal, threatening to wreck our walls as well as the buildings, and possibly entailing not only great loss of property, but the loss of lives as well. In order to stop this movement and avoid the necessity of rebuilding the walls, which, by the way, are founded on piles driven into quicksand—the tops of the piles being several feet above canal bottom—it was found necessary to drive long bearing piles and double rows of sheet piling along the walls so as to prevent the weight of the buildings from forcing the earth and quicksand under the walls and into the prism of the canal.

Two buildings near this section began to settle in such manner as to make it imperative that they be propped up and their foundations carried down to solid bottom and underpinned. These buildings were not on State land, hence there was no alternative but for the State to provide against possible collapse. This latter work could not well be classified, and constitutes one of the bills for extra work, which has been the subject of so much criticism by the Commissioners and the poorly informed newspaper press.

The Erie street bridge on this contract is another case in point. Its foundations were found to be on clay and that about seven feet above canal bottom. It seemed certain to collapse, but an effort was made to save it. It did finally succumb, despite all efforts to restrain it, and added largely to the cost of this contract. Prior to draining the section there was no indication of lack of security in this bridge or its foundations.

This contract No. 1 has largely exceeded both the preliminary estimate and the estimate at contract prices, but the increase has been due largely to the conditions mentioned, but if all the conditions had been determined before the contract was awarded it is extremely doubtful whether the contract could have been awarded for a sum equal to the final estimate.

The several contracts on the Jordan level furnish additional evidence of the impossibility of determining accurately, in advance, the quantities or even the quality of the work that will have to be done and the futility of even attempting to provide

for unseen and unknown quantities in the manner indicated by the Commission and its engineers.

This now famous Jordan level work has cost largely in excess of any estimates, but it does not necessarily follow from this fact that the manner adopted for doing the work could have been improved upon so as to reduce the cost. A large portion of this work was known to extend through beds of marl and quicksand extending to great depths.

If any one could foretell just how much could be excavated from the prism before the wall and banks would begin to slide, or just what device would be necessary to restrain the walls and banks from sliding when the excavation was started, that man has not yet been discovered. Piles from forty to sixty feet in length, driven at places on this work, have lifted to the extent of eight feet within twelve hours after the first driving was finished. The material to be excavated was frequently found to be higher after the excavation was completed than when it was undertaken, the entire bottom of the prism having lifted. Of course, it had to be done over again, and for this particular reason the excavation could not be measured on contract No. 4, and it could only be done on a "force account" basis. The excavation of small drainage ditches through the center of the prism has been sufficient at times to cause the walls and banks, and in one case a building standing at least 100 feet from the canal bank, to begin to slide. If we assume to be able to determine quantities and even the qualities or kinds of work that may be necessary to complete such a section of canal, then we must assume to know just how all these natural forces in these peculiar materials are going to act when the work is undertaken, and such a knowledge is not and can not be possessed by any mortal.

The Commission refers to the difficult work on this level, and among other things it is said that no special provision was made for the work which was known to be difficult of accomplishment. It might have been the part of wisdom to have estimated the cost of this work at a much higher figure than was placed upon it, but it was reasonable to assume that by careful work and such

amount of bank protection as was provided for in the bidding sheets, the work could be held in place and completed.

The difficulties in this connection, that have been mentioned in the foregoing contracts, apply with greater or less force to nearly all of the other contracts, but it must not be understood that the method works any injury to the State, which pays at fair fixed rates for the exact amounts of work it orders done, and the work is frequently done for less than any of the estimates, although the Commisison carefully conceals any mention of such facts.

Some of the difficulties, the manner in which they have been met, and the reasons for adopting the methods that have been pursued, will appear in other portions hereof.

2. Mucking and bailing and draining. "Under these contracts we have payments for grubbing and clearing, mucking and bailing and draining, which are clearly incidental to the main work, or a part of the provision required in its execution; and these are proper subjects for specification, the cost of the same to be covered in the prices on principal items."

2. This seems to refer to cases where sums additional to those named in the bidding sheet have been paid for the items mentioned. The whole case, however, has not been stated. No payments have been made for work of this kind that was shown or contemplated in the original plans on which the contract is based.

If, during the prosecution of a contract, a culvert is uncovered by the necessary excavation, and its condition is found to be so hazardous as to necessitate its reconstruction, and if this was not contemplated in the original plan and the culvert should happen to span a good-sized stream, then there can be no question about the State's liability of paying an additional amount for such bailing and draining; because it is a risk and involves work not contemplated, and constitutes a change of plan which usually largely increases the cost to the contractor. Once the work is properly drained, the masonry, etc., can reasonably be built at the same rates as under the original contract, and all rulings have been to that effect. In no other cases have additional payments of this kind been made, except in connection with Con-

tract No. 1 on the western division, where, because of the enormous increase of quantities over those estimated, it became necessary to maintain a pumping plant for many months longer than the time fixed for completing the work. At the time so fixed, more work had been done than was shown on the bidding sheets, and this amounted to more than twice as much as any other contractor had accomplished.

The contractor had been more than duly diligent and without complaint had maintained the work dry for a long time against this large increase of quantities. There was a reasonable limit to the time he could be expected to continue this process, and after allowing for that, the State paid the *actual* cost of the further necessary bailing and draining. No profit was allowed even for the wear and tear of machinery.

3. Slope wall. "Slope wall is specified by the cubic yard, and on its face the unit price represents the cost. It is, however, almost impracticable to ascertain the actual cost after the work is done, for, as a matter of fact, a variety of charges attach to the cost of slope wall. In measuring the yardage, the quantities are often completed on an arbitrary thickness. Lining is provided for filling the interstices, and for a certain thickness behind the wall, and this is allowed for at a separate price per cubic yard, and in many cases for an arbitrary quantity."

3. It is possible to ascertain the exact cost of either the slope or vertical walls, and the variety of charges comprising that cost do not affect the facility with which each of them is and can be ascertained. The quantities are not founded on an arbitrary thickness as stated, neither is the lining that is provided for filling the interstices paid for as lining. It is paid for as a part of the wall, just as mortar is paid for in the cement walls, and the specifications are clear on this point. The subject was, doubtless, misunderstood by the Commission's engineers. There are, in fact, the best of reasons why their recommendations are not well founded. For instance, all slope walls, whether old or new, are laid on *old* banks. If the material in the bank happens to be of proper character, no excavation and no lining will be necessary.

If the material in the bank is *not* proper, then it must be excavated and proper lining material substituted. It is another case of the State's paying for exactly what it receives, and this method avoids asking the contractor to assume any risks against which he would have to insure himself by bidding higher prices.

The work can not be compared to a contract for street paving, where the exact depths and quantities of excavation, etc., are definitely determined in advance.

4. Excavation for walls. "The excavation for the wall is also allowed for at the prices of excavation, and if any of the stone in the old wall are used, a deduction is supposed to be made of the quantities so used at an arbitrary price. It would have been much simpler and far more satisfactory, saving the use of arbitrary quantities and much labor in the measurements, to have based the price of slope wall on the superficial yard, as is done in street paving, and to have specified that the price per square yard should cover the completed work, including therein the necessary excavation and lining and the use of the old material.

"The same remarks apply with greater force to vertical walls, in which there are additional charges for back filling and for the excavation of old cement masonry."

4. If the excavation in the prism is paid for per cubic yard, there seems to be no good reason why the excavation for walls should not be paid for in the same manner. A deduction is not only *supposed* to be made of the old materials used in building new walls, but it is *actually* made, and practice has shown that it is best to fix an arbitrary price for these materials that are suitable for the new work, before the contract is awarded. The price is a fair one and all disputes are thereby avoided, and whether the price be high or low, it has been fixed, and as the contractors can and do bid accordingly, it is not clear how the State suffers or why a sliding scale based on price would have been any better or as good. The law directs that old materials shall be used when suitable and deduction made therefor.

The wisdom of the Commission's engineers regarding their contention that all of the materials and work incidental to the build-

ing of a wall should be included in the price paid for that wall, can not by any means be conceded. Under the system in vogue, the contractor is paid at specified rates for the amounts of work actually done and the materials actually used. Under the method suggested, it would be impossible for the contractor to determine in advance how many yards of excavation would be necessary to each lineal foot of wall, and he would, therefore, bid on an uncertainty, and would make his price high enough to protect himself.

Even though this quantity could be determined (the other quantities, of course, can be) the price he would then bid for each yard of wall would cover some excavation, lining, back-filling, timber, spikes and nails, and the materials comprising the wall, but is that any better than for each of these amounts to be paid for at separate rates? What difference does it make whether a wall of given dimensions is paid for at a rate per cubic yard, per square yard or per lineal foot or yard, so long as the price on either plan is fair? By the plan in vogue we simply pay for what we get. Moreover the laws governing the preparation of the estimates and the final records of work done, seem to demand that the course now in vogue be adhered to, that is, that the various separate items be explicitly shown and recorded.

It may be well to suggest here that these criticisms are merely a matter of opinion with the Commission's engineers, who have had no experience on this particular work, with all the red tape which it implies, and that their judgment is not, therefore, any better than that of our engineers, some of whom have spent their lifetime on these matters connected with the State's canals.

5. "The charge for earth excavation is usually to an arbitrary slope line, the earth often not being removed to this line when it will stand within, but paid for in full when it falls without."

5. The charge for earth excavation connected with the building of vertical walls is not as stated—usually to an arbitrary slope line. On the eastern and western divisions the amounts actually necessarily removed are paid for and the excavation is ordered done to as steep a slope as seems to be justified in the particular material to be handled.

On the middle division it seems to have been the practice for many years to allow for excavation back of vertical walls to an arbitrary slope line of one-half to one only. This is substantially the slope to which the excavation must be made in the great majority of cases. Once in a while it happens that on account of the nature of the materials or the condition of the weather, the slope is necessarily made sometimes steeper and sometimes flatter. In one case the State loses slightly and in the other case it gains, and the division engineer of the Middle Division, who has spent over thirty years in various capacities in this Department, claims that in the great majority of cases the State's interests are best protected by this method. This ruling on that division has been carried to the extent of compelling the contractors to prop up and maintain large brick buildings which overhung this arbitrary slope, during the construction of the walls, without any compensation beside that allowed for the slope as stated. At any rate this method avoids a considerable amount of engineering work, and, therefore, of cost, and it also avoids paying for any quantities in excess of this slope, and those quantities are by no means small. It can not be conceded that the practice has injured the State, and it is even probable that the reverse is true, but it should also be stated that prior to the recent investigation, this practice on the part of the Middle Division was unknown to the head of the Department.

6. "The charge for back-filling is usually to an arbitrary line, also, even when the earth has not been fully excavated, with a full charge for filling outside the slope line. A charge for lining is made in some cases, and a separate charge for the footings of timber which may be placed under the wall. A deduction is supposed to be made for the use of any stone from the old wall, as in the case of the slope wall. It is impossible to verify the actual cost of the wall."

6. The foregoing remarks also apply to and seem to cover this criticism. The Commission's engineers are in error in stating that the back-filling, and in some cases lining used behind vertical walls is paid for according to arbitrary measurements. Such is

not the practice of the Department, though it may have been done without the State Engineer's knowledge in some particular cases where the reasons therefor probably justify that course.

7. "It is practicable to so specify vertical walls as to include all work incidental to its construction and to pay for the same at so much per yard of wall actually built. Had these two principal items of slope wall and vertical wall been treated in the manner suggested, it would have disposed of the most vexatious features in the measurements for excavation."

7. Had the items of slope and vertical wall been specified in the manner suggested, it would not have disposed of many vexatious features, but would only have introduced new ones, but whether it did or not makes absolutely no difference since the State pays only for what it actually receives. In the manner suggested, the contractor would be forced to bid at a rate high enough to protect himself against contingencies. The Canal Law (chapter 338 of 1894) and the special law governing this work (chapter 794 of 1896) both say:

"No work shall be contracted for upon any of the canals, until the division engineers ascertain with all practicable accuracy, the quantity of *embankment, excavation, masonry*, the quantity and quality of *all materials to be used and all other items of work to be placed under contract*, and a statement thereof, with the maps, plans and specifications, corresponding to those adopted by the Canal Board, and on file in the office of the State Engineer, is publicly exhibited to every person proposing or desiring to make a proposal for such work. The quantities contained in such statement shall be used in determining the cost of the work, according to the different proposals received."

8. Earth and rock classification. "Earth and rock have been so defined as to lead to diverse practice throughout the canal, and too much judgment has been exercised by the resident engineer.

"Usually rock is classified as material most economically removed by blasting, and earth as material most economically removed by plowing. The distinction is arbitrary and turns upon whether a man would blast or plow in working for himself. This

is believed to be the proper interpretation of the language of the specification. No definite standard has been applied, and the language has been construed to mean ordinary plowing with two horses, as understood in tilling ground and in other cases with four horses, but in very few instances has any *bona fide* attempt to plow been made. The engineer's judgment should confine itself to the comparatively narrow zone between what is economically blasted and that which is most economically plowed; nor, on the other hand, should the contractor be required in making his bid to discount the personal equation of the engineer in charge. It is not meant to include in rock a class of earth, the removal of which is facilitated by shaking up with explosives, as is often done in steamshovel operations."

CLASSIFICATION.

8. This subject of classification is one which has been a bugbear to engineers and contractors always, and we have yet to learn that any one has ever succeeded in so defining which of the many kinds of hardpan could properly be classed as rock under specifications which provide for classification, and which could not be so classified. With the question of the judgment to be exercised by the resident engineer, neither of the departments seem to be responsible. The laws provide that on each division there shall be one division and one resident engineer, and that the resident engineer is to particularly have charge of and direct all field operations, and the law and the contracts provide that since he is the engineer who is expected to be on the ground and be familiar with all the circumstances and conditions, that he shall determine these questions of classification.

Throughout the investigation the Commission's counsel kept repeating his inquiries as to whether or not it made any difference if a contractor was known to be losing money, or words to that effect, and it is believed that the answers were uniformly to the effect that the matter of profit or loss to a contractor did not affect the question of classification, but that the actual cost to the contractor was always a factor in determining the classification. Between the two wordings there is quite a distinction on closer

study, and in this connection particular attention is called to the report of the Commission's engineers (page 8).

It appears that the Commission's engineers agree that cost is a factor in determining classification. But suppose our specifications had provided that all materials that could most economically be removed by blasting would be classified and paid for as rock? Then all frozen material would have been paid for as rock for it certainly can not be plowed by any means. The fact is that an intelligent, concise *definition* of what materials will be classified is a practical impossibility, yet there is little difficulty about an intelligent decision by an experienced engineer, who has before him a full knowledge of conditions, methods and cost.

Cost has always been and always will be a factor in this determination because that alone indicates whether a man should blast or plow if working for himself. The statement that the plow test "has been constructed to mean ordinary plowing with two horses," has no foundation in the facts nor the testimony, and is a gratuitous insinuation.

The plow test is the one most commonly prescribed, but it does not require any great amount of brains or experience to indicate that a great deal of excavation must be done in places and under conditions that preclude the possibility of applying the plow test. Practically every yard of excavation for walls and structures and the material near the walls is embraced under this head, for in such cases it would be impossible to handle a plow and the required number of horses. The decision must, in these cases, be based on the hardness and cost of removing these materials as compared with similar features in places where the prescribed tests can be applied.

One might imagine from the reports that the prescribed tests had been entirely overlooked, but that is not the case, and what is said on this subject by Resident Engineer Morris of the middle division applies equally to the other divisions, and in nearly every case the conclusions are arrived at only after thorough deliberation and consultation.

Mr. Morris says, "The Syracuse Chilled Plow Company manufacture the heaviest grading plow that is known, and I have had

eight of the strongest horses put on to one plow, and compelled the contractor to manufacture special eveners, and have had as many men on the beam of the plow as could be placed there, and with four men directing the handles, on one contract four of these plows were broken, and on the other contracts I did not think I was called upon to break more than one plow in order to ascertain the degree of hardness, and when hard material was so hard that it could not be moved with a plow and this material would be the same throughout the entire contract, I did not feel that it was a 'violation of my duty' to compel the contractor to continually keep attempting to plow material that I knew could not be plowed.

"On Contract 34, the contractors had to excavate some hard material that was just above a lock at Hinmansville. They could not properly drain their work without taking up the breast wall and mitre sill, and as they had to lower this level two feet they tried very hard to plow it with sixteen horses. They afterward rigged up a 'Lidger wood' engine and tried by this method, but failed to make any impression, nor could they with either method get the point of their plow into the material, and had to resort to blasting. This same material was similar in nature to the sample that was exhibited by Resident Engineer John G. Tait of the eastern division, and with which the consulting engineer for the Commission tried to amuse the audience and make headlines for the newspapers by placing his sample in a basin of water, where it disintegrated rapidly. I contend that no power that could be applied to the plow could plow this same material on Contract 34, yet at the same time it immediately disintegrates when exposed to the elements.

"I called the attention of some of the Commission to the fact that some of the hardpan excavated by blasting would come out in the shape of quarry stone and look very similar to a 'waste heap' in a rock quarry, but that the same material after short exposure to the elements would break up like slack lime, and in some cases, where it would hold its form for any length of time, a slight blow like the kick of a foot would break up a piece that would contain two or three cubic feet into very small pieces.

On another contract there was a cemented gravel that I insisted that the contractors should satisfy me about, and compelled them to make the attempt to plow the material, and even tried to hold the plow myself, but the point would not catch and it could not be plowed, and afterward it was necessary to blast this all out, and half a stick of dynamite to the hole would blow out less than a wheelbarrow full of material, simply making a number of 'pot holes.'

"In other localities the shale was of such a nature that it could not be plowed by using any number of horses, but, after it had been blasted and shaken, they could, by using four horses, plow portions of this. Although the resident engineer has not seen every yard of classified material excavated, he has made it his duty to determine, before he did make any classification, that the material was such that it would have to be classified and was classified material, and where he was in doubt, he applied the necessary test to his entire satisfaction and the Court of Claims will discover that there has been a great difference in opinion between the contractors and the resident engineer."

No attempt is made by the Commissioners or their engineers to separate the materials properly classified from those improperly classified, nor do they even indicate their judgment as to the proportionate amounts. From this cause and the amount of time and space devoted to this subject in the investigation and reports, the popular opinion seems to be that about everything that was not silt has been classified as rock. The actual figures are, therefore, interesting and might fairly have been incorporated in one of the reports in justice to all concerned.

	Eastern division.	Middle division.	Western division.	All divi- sions.
Total of all excavation, cubic yards ..	1,695,675	2,840,665	1,523,757	6,060,097
Total classified excavation, cubic yds.	51,477	158,540	88,328	298,345
Per cent. of excavation classified .....	.0303	.056	.058	.049
Cost of classifying	\$53,512	\$130,292	\$114,602	\$298,406
Average cost of earth excavation .....	.258	.263	.282	.....
Average cost of rock excavation	1.24	1.002	1.694	.....
Average cost of all excavation .....	.338	.344	.515	.....

Attention is particularly called to the low averages of cost of the items of excavation, and to the small portion of the total excavation that has been classified as rock. On 300 miles of work costing \$9,000,000 only \$298,406 has been spent for classified materials, and even that sum includes what has been termed the "proper" as well as the "improper" classification. We do not admit that any of this was improperly classified.

There are only two ways to avoid this question of judgment regarding classification:

(1) Pay at one rate for all excavation, letting the contractor take all the chances and bid accordingly; or

(2) Pay at one rate for absolutely solid ledge rock, and at another rate for all other excavations, again letting the contractor take the chances of hard material.

Either of these plans is universally expensive and would surely have increased the above-mentioned average prices, which are lower than on plenty of similar work recently contracted for.

As a matter of fact there are a great many well-known kinds of earthy materials that can most economically be removed by blasting. Frequently the question as to the comparative economy depends on circumstances, and since actual cost is a factor in the determination, the attendant circumstances which influence that cost must also be considered. It is one of the impossibilities to judge of these points intelligently without a thorough knowledge of all the conditions at the time when the work was done. Some kinds of hardpan after being blasted look like and can be shoveled as easily as sand. Immediately after blasting it may have the appearance of being slightly moist, but to all appearances it is actually nothing but sand. However, after being loaded into carts or cars and hauled a few hundred feet, it assumes the qualities of a sticky mortar, frequently overturning the ordinary dump cars by adhering thereto when they are dumped. Once placed in the embankment, this material will run to very flat slopes and have every appearance of being nothing but slimy mud. Any one looking at such material after it had been placed in the embankment would certainly be justi-

fied in assuming that it could easily be plowed, and the Commissioners seem to have based much of their judgment regarding classified material on just that sort of evidence or inspection. They ridicule one of Mr. Morris' samples of classified material because on being immersed in water it softened up to such an extent as to assume the shape of the paper in which it was afterwards wrapped. That fact had no bearing on the quality of the material and the difficulties and cost incident to its excavation, unless the conditions in the applied test were identical with those governing the particular work. There are many well-known grades of clay that can not be plowed under certain conditions, and some kinds of gravel are more difficult and expensive to drill and excavate than absolutely solid ledge rock, but after being blasted it may look like ordinary gravel.

Moreover, the Commission says: "We have found, however, on all the divisions, material classified as rock which was loosened by picks and which, undoubtedly, could be more cheaply plowed than blasted." The inference is that they believed that material that can be picked can be plowed, and if that is their judgment they certainly are in error. The great bulk of excavation to be done on this work consists not in great deep masses, but in a thin skimming, and this is frequently so thin as to render blasting even more expensive than the use of picks, even using four or five pickers to one shoveler. There is comparatively little of the excavation in the center of the canal that equals two feet in depth, even where the levels are to be deepened wholly by lowering, and the bulk of this is covered at least to some depth by silt. After removing the silt, there may remain a few inches of material that should be classified as rock, because it could not be plowed economically, yet any one acquainted with the use of explosives also knows that unless the drilling in such cases extended far below grade, thus costing a useless outlay of time and money, they could not be made effective. In such cases picking is resorted to, and the progress made is so slow as to render the cost equal to that of blasting, where the conditions would make blasting the proper method. The Commissioners

frequently state that the holes drilled for blasting this earthy material were made with a drill driven into the ground with a sledge. *Solid rock is drilled by hand in the same manner*, and the statement means absolutely nothing without the knowledge of the cost, number, depth and efficacy of holes so driven. The effect, however, on the public mind is a slur against not only the intelligence, but the integrity of the engineers of this Department. This question of classification is not confined to a few spots on the canal, but extends in spots throughout the entire length of the work, and I submit that it was out of the question that all of the engineers who have to deal with this problem are mistaken in their views of it. One might infer also by reading the Commissioners' report that the decisions on these matters were all reached in a decidedly haphazard manner. The reports are not fair in this matter. Even where the testimony shows that attempts to plow have been made—see Eastern Division Contract No. 4—the report says such attempts were not made. They have been made wherever there could be a question, and careful records of progress and cost have been kept.

Volumes might be written concerning this feature of classification, which has always been the bone of contention on all public works, where a distinction has been made in the kinds of material to be excavated.

Mention is made in the reports (and, of course, in the press) of a sample of hardpan from the Middle Division that was so soft as to assume the shape of paper in which it was wrapped for preservation. According to reliable witnesses of the occurrence, it develops that the sample in question was not a clean one from the excavation, but had dropped from a wagon into the mud of the wagon tracks, and it was this covering of mud which proved to be so soft and not the sample itself.

Nearly all grades or combinations known as hardpan, whether of the nature of clay, cemented sand and boulders, cemented gravel or shale rock, will disintegrate quickly on exposure to the elements. Some well-known kinds of building stone do the same thing within certain limits. It does not follow that these mate-

rials are soft enough when excavated to admit of their being plowed, but it *does* follow that an intelligent judgment of the point involved requires a knowledge of the actual conditions when the work was done. *This can not be obtained from a study of the spoil banks.*

To illustrate this point further, I quote the following letter from David E. Whitford, of the Middle Division. Mr. Whitford has been employed in this Department, under both Republican and Democratic administrations, most of the time for *over forty years*, and because of his ability, has occupied positions under all the grades up to and including that of division engineer. He says:

“In reply to your question regarding my experience in the classification of material, I will say that previous to the improvement under act, chapter 79, Laws of 1895, the specifications have generally included hardpan with earth excavation. Classifying it as earth, however, has, in many instances where hardpan was not anticipated, proved very severe upon the contractors, while upon the other hand, when it was understood that hardpan would be encountered, the prices bid for ‘all excavation except rock or old masonry,’ would sometimes be exceedingly high and detrimental to the State, especially where a very small proportion of the excavation proved to be hard.

“I have been greatly surprised at times where hardpan, in its natural bed, seemed almost as hard as rock, to find that soon after it was excavated and exposed to the air and elements it would disintegrate so readily. We had examples of this kind when lengthening locks No. 47 and 49 on the Erie canal in the winter of 1886 and 1887. The plan adopted provided for bearing piles for the foundation, but just before reaching bottom grade of the pits we struck hardpan, and, notwithstanding that we were well satisfied in our own minds that pile-driving for the foundation was practically impossible, still we did not feel justified in omitting to make the trial, therefore obliged the contractors to put their pile drivers in the pit at lock No. 47 and make the effort. The machine was placed in position January 7, 1887, and an at-

tempt was made to drive pile No. 1, with poor results. The following day about ninety blows were given to pile No. 2 with a 2,000 pound hammer, falling about twenty-five feet, with a result of thirty-nine inches penetration into the hardpan.

"January 10th seventy-one blows were given to pile No. 3, driving it twenty-six inches into the hardpan. Iron points were fitted to the piles. Had they not been the natural wood they would have made but little impression upon the hard material.

"We reported the result of the trials to the State Engineer and Surveyor, and he came and witnessed an effort to drive a pile, and went away well satisfied that it was impractical to drive the bearing piles. I am explaining thus minutely this particular case for the reason that it seemed almost incredible that material so hard in its natural bed would dissolve in so short a time after being exposed to the air.

"These double locks were built about sixty years ago, or soon after the act of 1835, which authorized the enlargement of the Erie canal. And from the very fact that their foundation timbers rest upon this hardpan they have given us more trouble than any other locks on this division of the Erie canal.

"It is quite natural to infer that those in charge of their construction concluded that this hardpan was excellent material to build upon, and it would have been if the air and water had been entirely excluded. But the water slaked the top of the hardpan and turned it to mud, and when any of the foundation plank got loose or were displaced the water had free access to the timbers and was forced along them from one lock to the other by the ten and five-tenths feet head (when one lock was full and the other empty), and this constant churning or pumping back for years finally undermined the locks in places to such an extent that navigation was necessarily suspended for several days until cofferdams could be built, the water pumped out and foundations repaired. This has occurred several times during the past thirty or forty years.

"The first intimation that anything so serious was transpiring was when some of the floor plank in both locks had been displaced

and so much gravel from between and material from under the timbers had been forced up into the chambers of the locks so as to form bars upon which the loaded boats got aground.

"The foundations have been so thoroughly repaired by ramming concrete under them that they are considered quite secure now.

"Another notable case of failure in a foundation where too much reliance was placed in the hardpan bottom for its security was at Crane Brook aqueduct. A breach under the west abutment in the prism of the canal occurred there in July, 1891, and navigation was suspended nine days in consequence. The abutment was made secure for the time being, but it settled and cracked to such an extent that it has since been taken down and rebuilt upon a substantial foundation. In describing this failure to a person who was present when the aqueduct was built, and asking why bearing piles were not used, he replied that the hardpan there was about as hard as flint and that but little impression could be made either with bar or pick, consequently it was utterly impossible to drive piles.

"I am dwelling upon these particular cases at much greater length than I otherwise would, because so many seem to doubt the propriety of classifying any material hardpan that will disintegrate so rapidly when exposed to the influences of air and water."

Since this question of classification usually leads to trouble, because of a misapprehension on the part of those not well informed of all the circumstances in the case, the engineers have inaugurated various methods of checking the cost of classified material and comparing the same with the cost of excavating true ledge rock. On the Western Division this record has, perhaps, been more complete than on either of the other divisions, and the data there, covering a large number of averages in varying conditions, indicate a yardage excavated per man per day of ledge rock and hardpan as 3.53 and 3.74 cubic yards respectively. This, however, does not take into account the use of machinery, helpers, etc. It shows, though, that the cost of excavating rock and hardpan is substantially the same.

It must not be forgotten that the character of the work in question does not usually admit of the economical use of elaborate machinery plants such as have recently been invented for similar work of much greater magnitude, and that the cost of removing material on this work is, therefore, necessarily greater per unit than, for instance, on the Chicago Drainage canal, where the enormous quantities per running foot justified the purchase of the necessary plant, which was the secret of the low prices on that work.

“Reclassification.” While on this subject of classification of earth as rock, it seems proper to advert to that portion of the Commissioners’ report which criticises what they have insisted on calling “Reclassification.” They have been told and shown time and again during this investigation why it was absolutely impossible for the resident engineer to render a decision on these matters exactly at the time the work was done. As a matter of fact, the course pursued was the customary one on all work of this kind, and it has not led to any abuses whatever. It is the duty of the resident engineer, under the law and the contract, to decide these matters of classification, and the assumption at least is that his decision must be subject to revision, if necessary, by the head of the Department, who is and necessarily must be the party to be held responsible for any acts of omission or commission by his subordinates. With the work scattered over 454 miles, much of which (about 300 miles) has been progressing at one time, it was a physical impossibility for the resident engineer to be on the ground when he was wanted to determine these matters. The assistant engineers, in case of the inability of their superiors to decide these matters, have, according to instructions, kept on the safe side in their estimates and returned the questionable material as earth, pending a final decision by the proper authority. Records and measurements are kept in the meantime and it has frequently been found necessary to watch the progress of the work for some time, under varying conditions of weather, etc., in order to arrive at what is deemed an equitable ruling, in so far as the Department’s engineers seem

to be clothed with the authority of considering equity. It does not, therefore, follow that because of a given quantity of material being returned as earth in one monthly estimate and as rock in the following estimate that any injustice to the State has resulted. As a matter of fact, if the material was properly classified, the only injustice was done to the contractor by withholding from him the money which he had properly earned.

It is not customary on this work, nor on any other public work, to attempt to provide for any great degree of accuracy in the monthly estimates. The expense of doing so would be unwarranted, and the usual course is to keep on the safe side.

The statement of the Commissioners that the approval of the monthly estimates by the resident engineers is *prima facie* a classification of the material as between earth and rock, is simply ridiculous. If the ground for their assertion is tenable, then a mistake, though approved in one monthly estimate, could not be corrected in the succeeding monthly estimate without recourse to legal proceedings. Such a view smacks too much of opera bouffe.

If a decision as to classification had to be made from month to month it would be reasonable to expect that much frozen earth would be classified as rock, for it frequently becomes necessary under the present methods to wait until the frost is out of the ground to determine features of classification. With the distance which each resident engineer is obliged to cover, it is ridiculous to expect that a final determination on all these points shall be made from month to month as suggested by the Commissioners.

The Commissioners say that we should have had more resident engineers, and that they should have been chosen from men of recognized skill and experience. The law, however, says that not more than one resident engineer shall be employed on each division, and as if to cripple the head of this department in this respect, the Civil Service Commission in its wisdom (?) saw fit to place the resident engineers, who, by the way, are each under \$10,000 bond, on the competitive lists, at about the time this work was started. The State Engineer protested against this

ruling without avail. It has not thus far affected the work of the Department, and it is only mentioned here to show the amount of red tape which binds and sometimes prevents a State official from performing his sworn duty to the best of his ability.

9. Embankment and overhaul. "Overhaul beyond a limit of one thousand feet has been construed as embankment, as hereinafter noted, and has been the subject of abuse. Had overhaul been contemplated, it should have been provided for in the usual manner through an additional charge for each hundred feet necessarily hauled beyond the limit. A full reading of this specification convinces us that it was not intended to require the contractor to haul excavated material beyond the limit of one thousand feet, and that it was intended to provide spoil banks or other means of disposal within these limits. When overhaul became necessary, therefore, a special arrangement was required on some rational basis. Excavation hauled over one thousand feet and wasted has increased in an extraordinary degree the estimate for embankment. The spoil ground should have been located, or otherwise the contractor required to dispose of the material, as is usual in city contracts, and the bid should have been made to cover.

"Embankment was evidently intended to include only such material as actually entered the banks, when such material was hauled over one thousand feet, or unloaded from scows, or necessarily handled twice, in filling behind walls and around foundations. Embankment made from material taken from the prism of the canal within one thousand feet was to be done without extra charge above the price of excavation. This specification for embankment has been given a forced construction by including materials necessarily hauled over one thousand feet and wasted, as before noted. It has apparently led to a large use of borrowed material for forming the banks, which has usually been paid for in excavation, rather than a use of the material from the prism of the canal, on the plea that the material taken from the canal was not suitable for the purpose. All of these practices have contributed to increase the cost.

"We believe that embankment should have been specified throughout as a separate item, meaning actual embankment only, and that it should be bid for at a price per cubic yard without regard to the source from which the material was obtained. Had this been the practice, we are persuaded that the material, with few exceptions, would have been obtained from the excavation."

9. Both the Commissioners and their engineers have formed some very erroneous impressions regarding the feature of the work known as "Embankment," and this erroneous opinion on their part forms a basis of much adverse criticism which is surely not founded on the testimony nor the specifications. Nearly every statement made on this subject on pages 8 and 9 of the engineers' report, and throughout the Commissioners' report is in error, notwithstanding the State, deputy, division and resident engineers have all tried, and as they believed, with success, to convince the Commissioners and their engineers of the lack of foundation for the views which they were known to hold on that subject. Briefly stated, their conclusions are that we did not intend to and should not have paid embankment price for materials hauled more than one thousand feet. The specifications define this work in such unmistakable terms that there would seem to be no possible reason for any misunderstanding, and that the reverse is true only serves to indicate the ease with which a public official can be criticised in such manner as possibly to destroy his reputation for official honesty and professional ability.

Under the head of "Excavation" the specifications say:

"All materials excavated shall be deposited in such places as the engineer may direct and where they can be used in raising or strengthening the canal banks or in filling behind vertical walls, or in grading bridge approaches and near-by roads, they will be so placed and used, and no price will be paid for such embankment work regardless of the quality of the materials, other than the price paid for the excavation of the materials, *unless the distance between the place of excavation and deposit shall exceed one thousand feet.*" (See "Embankment.")

Under the head of "Embankment" the specifications say; "Embankment will be paid for in place on completion, but only such embankment as is made from materials necessarily unloaded from scows or *necessarily hauled more than 1,000 feet will be paid for as 'Embankment.'*" How there can be any question in view of the above italicized quotations about the intention of the specifications or the liability of the State to pay for materials necessarily hauled more than 1,000 feet is beyond comprehension.

The policy of leaving to the contractor the disposition of surplus excavated material has heretofore been the subject of abuse and adverse criticism, and it was thought best in this work, and in all other canal work of recent years, for the State to control the disposition of such materials. The intention was, and it has been followed wherever practicable, to acquire spoil banks for wasted materials within the 1,000 feet limit of haul, and in the vicinity of cities and villages this has not always been possible. The word "embankment" has from years of precedent in canal matters been made to cover waste material, as well as the material required for necessary embankments, and though the Commissioners criticise the use of the word, we can not see what difference the name of the material makes, neither can we see why there should be any distinction about paying for materials hauled over 1,000 feet, whether they form part of the necessary banks or are wasted. The cost to the contractor for hauling is the same in either case, and it is to cover that cost that he prepares his bid. The necessity for paying for embankment on railroad work is seldom conceded nowadays because the distance from the point of excavation to the point of deposit can always be accurately foretold, the direction is always along a given line and all the conditions can be determined in the beginning. Modern railroad specifications, however, usually fix a limit of haul at 1,000 feet beyond which a fixed rate, usually about one cent per cubic yard, for each additional 100 feet, is added to the price fixed for excavation. That plan, however, is not feasible on canal work. The difference between building embankments to carry the weight of a railroad train and building them to withstand water pres-

sure can not be overestimated. It means that in the latter case, or the canal work, that the excavation, as it progresses, may and usually does uncover hitherto unknown conditions. These conditions may render it necessary to procure gravel and clay from distant portions of a contract for use in puddling, or the materials necessarily excavated may be of several different kinds within a short distance; some of these kinds may be suitable for as many different portions of the work, while others are useless for any purpose and must, therefore, be wasted. This means that material is hauled in all sorts of directions, and for this reason any attempt to provide for the item of overhaul in the same manner as usually adopted by railroad companies is neither feasible nor desirable. It would require a small army of engineers to record the measurements and distances hauled, and at the best no tangible record thereof could be had as required by law. It would inevitably lead to serious abuse without accomplishing any desired end. The idea on the part of the Commissioners and their engineers to make this branch of the work conform more closely to modern railroad practice is all right so far as it goes, but the idea can not be put into execution because of practical reasons which they, in their inexperience on the particular work in hand, have entirely overlooked. Some years ago it was the practice of the Department, and also on most railroad work, to pay two prices for all excavated material, that is, one for removing and one for depositing. The old specifications on file in this Department prove this beyond question. Later it was seen to be possible to eliminate the "embankment" feature within certain limits of haul, and that limit was then placed at 200 feet. Later this limit was changed to 600 feet, and one of the first acts of the present administration was to change this limit in the "ordinary" or so-called "section specifications" to 1,000 feet, and that practice was found to work so satisfactorily that it was incorporated in the canal improvement specifications. The elimination of the embankment feature within this limit avoids the necessity of measuring, estimating and afterward recording the cross sections, etc., incident to that work.

The Commissioners criticise the excess of embankment over that shown in the bidding sheet, and while a full statement of certain specific cases which they criticise will be found in other portions of this statement, it should be said here that the fact that the great bulk of the excavated materials which were expected to be used in making necessary embankment were found unfit for that purpose, and had to be wasted, accounts in a large measure for that increase. It was not always possible to secure spoil banks within the 1,000 feet limit of haul, especially through cities and villages.

The necessary wasting of this material has made it necessary to procure other material for the necessary embankments from so-called "borrow pits," and these also are not only frequently but usually at considerable distances from the points where the material is needed. In some cases the haul has exceeded two miles.

This will indicate why it was important to fix a limit of haul beyond which one price should cover the work regardless of distance. Owing to the prejudice against the material excavated from the canal on sanitary grounds, the local boards of health, in several localities, have prevented the placing of this material at points within the 1,000 feet limit of haul, and an increase of cost has resulted. For the same reason we have been compelled to spend \$6,684 for disinfection.

It has not been charged or even intimated that the embankment price was too high except in one case (Waterford), and how the State would suffer by paying at fair rates for the work it requires done, is not clear. *Unless part of the cost of the long haul is paid in embankment, then a greater price would have to be paid for excavation.*

All that is said on this subject on pages 99, 100 and 101 of the commissioners' report is based on erroneous conclusions, not in accord with the specifications nor with the practice of the Department. Indeed the facility with which this Commission can inform us what our intentions were and were not, in regard to this work is quite remarkable.

10. Puddling. "Puddling is a proper and necessary item of work, but to pay for the material for the same under two or three different classifications, and then to pay again for the actual work of puddling in place, is bad practice. Puddling should have been specified at a price per yard in place, the same to include all the material and work required."

10. This is another case of the opinion of the Commission's engineers as against that of the State's engineers, with the latter backed up by years of experience and precedent in the particular kind of work. The effect of the statement is the assertion that wrong methods were used, and the inference, therefore, follows that the State suffered, and it is this sort of indefinite statements on the part of the Commission and their engineers which characterize almost the entire report, and make it quite impossible for any one to answer their arguments specifically. No attempt was made to show wherein the State suffered by the method adopted. This portion of the specification is exactly the same as has been used for years on other canal work, and after being carefully weighed, has not been found wanting. If it were possible to locate in advance those points where puddling would be required and from whence the materials therefor must be taken, then the arguments of the Commission's engineers would be proper, but such is not the case. Puddling materials were expected to be found in most cases in necessary excavation, and in such cases only the cost of puddling the materials is paid for, while if the materials are necessarily procured from distant points, the cost will be increased proportionately, and this is then covered by the contract prices for the excavation or furnishing of the required materials.

We maintain that this is the most equitable arrangement that could be devised, and at numerous places, notably Syracuse and St. Johnsville, it has resulted in considerable saving to the State, while at no place has it resulted in the payment of an excessive price.

In fact the fault-finding reports do not claim that it has, but they merely intimate that it might have been done differently. Of course it might.

11. Lining.—“Lining seems also to be an unnecessary item which could have been entered in the specifications as requirements of the construction of towpaths, of the back-filling of vertical and slope wall and of other work requiring lining.”

11. The foregoing remarks under No. 10 (Puddling), apply with equal force to this item of lining. It is believed that the Commission's engineers acted honestly and in good faith in criticising these features of the specifications, and though they are men of high professional attainment and large experience, it does not necessarily follow that their suggestions are well founded. If the reverse is true, then the engineers of this Department for many years have been pursuing the same improper methods, and it does not seem reasonable to believe that the experience of years in these matters has not shown the error of these ways or that the error existed. The very fact that the reverse is true ought in itself to be sufficient evidence that the criticisms of the methods are not well founded.

How lining “could have been entered in the specifications as requirements of the construction of towpaths” is not clear since we do not pay for building towpaths by the foot or yard. The work on the towpath is paid for according to actual requirements and work done. If built from the materials necessarily excavated, it costs nothing. If necessary excavation does not provide suitable material for the purpose, then they are procured from other points and paid for at fixed contract rates. We pay for just what we get—no more and no less.

The Commission's engineers further say, relative to their suggestions regarding specifications, etc., that if they had been adopted “it would have given confidence alike to the contractor and the engineer, and resulted in lower prices and a better administration.”

That also is merely their opinion, and so far as the prices are concerned, it is susceptible of proof that they are now too low in most cases. Men of experience in these matters know that it is best always to award contracts at rates which will insure a fair margin of profit, and there is no reason why the great State of

New York should expect to have its work done for rates other than these. It can, however, be proven by the force accounts kept by our employes, that the greater portion of the work has either been done at a loss or at an unreasonably low margin of profit. The tabulated figures showing averages of cost emphasize the above statement, and it is confidently believed that the average prices are as low or lower than for similar work in other localities. Occasionally a high price is introduced into some of the bids; that, however, can not be controlled, and it does not necessarily follow that the State suffers. This is emphasized on some of the contracts where some of the work is done at a loss, though comparatively high prices are paid for one or two items. Naturally this feature must then be considered in all the contracts, and should have been considered by the Commission when they called attention in their report to some rarely exceptional cases of high prices.

The Commission's engineers say, "We can only emphasize the necessity of proper surveys and studies on which to base specific contracts." With this we are fully agreed, and we must admit that the surveys in many cases did not disclose a proper preliminary estimate of the cost of the work. In some cases the reasons for this were good and sufficient, and in other cases errors, oversight and incompetence such as is certain to be encountered in spots on any work of this magnitude have had the usual result. It can not, however, be conceded that by increasing the quantities, the State has not received full value for practically every dollar expended.

SCOPE OF WORK COVERED BY COMMISSION'S ESTIMATES FOR COMPLETION, AND CHARGES OF IMPROPER EXPENDITURES.

The next statement of the Commission's engineers which seems to require comment, refers to the matter of estimates for completing the work, and attention is called to their statement (page 12) that their intention has been "to make the estimate liberal enough to enlarge the canal and restore all structures that are liable to

require repairs or restoration within ten years." Such an estimate has no bearing on the work in question until the Legislature shall have enlarged its scope. It is, however, somewhat remarkable that these engineers should include in this estimate the "cost of strengthening banks and repairing or renewing locks, aqueducts, waste-weirs, etc., not thought necessary by the State Engineer."

If the statement means anything at all, it is that if the work were placed in their hands, they would plan to do even more than the present officials have done toward the rebuilding of structures and the thorough renovation of the canal, notwithstanding the work might not necessarily constitute a part of the improvement authorized. When this work was started, the canal officials had to encounter the conditions as they then existed, and if it became necessary to the integrity of this work to do something which should have been done years ago from other funds, but had been left undone, it has been ordered and paid for as a part of the cost of improvement. This seems to be all right when planned or suggested by the Commission and its engineers, but all wrong when done by the canal officials, for the doing of certain absolutely necessary work of this kind forms the basis of the Commissioners' report that one and one-half million dollars have been "improperly expended," that is, for work that should have been done under ordinary repairs, or other appropriations.

To have done this amount of work from other funds presupposes the availability of those funds, but whether or not they were available, or whether the work was absolutely necessary as a part of the present improvement, or whether the State got value received for the expenditures as made are apparently such trivial matters as not to require any definite statements or explanation in the reports either of the Commission or its engineers. The newspaper press, of course, sees the statement of one and a half millions improperly expended to the exclusion of all other things relating to the subject, and as a result, the canal officials are described to the public as all kinds of thieves and rogues deserving nothing better than impeachment, removal or imprisonment. Why did the Com-

mission and its engineers skip over this matter which now seems to involve the reputations of so many men in such a careless manner?

Between the criticism of this so-called improper expenditure of \$1,500,000 for ordinary and extraordinary repairs, several pages intervene with a mass of other statements until, on page 145, they say: "While we have criticised the expenditure of a part of the \$9,000,000 fund for work that should have been taken care of by the ordinary and extraordinary repair funds, we would call attention to the fact that the objection is based upon the legality of such expenditure and not upon its propriety. The State gets the full benefit of work which, in its nature, is repair and not improvements, and practically it makes no difference from what fund it is paid for."

It is evident that the partisan press has not read the above-quoted paragraph. The Attorney-General, who is a member of the Canal Board, and the State officers who have constantly to deal with these matters are quite as able to decide about the legality of these expenditures as were the members of the Commission or their engineers or their counsel, and there can be no question about the work that has been done being a part of and absolutely essential to the completion of the improvement work. The canals can not be deepened without removing the accumulations of silt, and it is simply silly to assume that it would be proper to leave aqueducts, culverts, waste-weirs and other structures in such condition as to jeopardize the integrity of the canals simply because their improvement or rebuilding was not specifically mentioned in the improvement act. In fact, the whole purpose of the improvement would simply be nullified by failing to do such work when it is found to be absolutely necessary.

The statement made by the Commission that its objection to these expenditures is not based on their propriety is sufficient indication that they knew that the work that has been done was absolutely necessary and their further statement as to what work they would plan to do to complete the improvement further serves to clinch this point. This being the case, why

should they not have stated the facts honorably, and what was the real underlying reason for their making the statement that *any* money had been improperly expended for work of this kind? Has it served any purpose whatever except to besmirch the reputations of the canal officials and to poison the public mind against further appropriations for the improvement of any of the canals?

The further charge that another \$1,000,000 has been improperly expended as a result of poor specifications, bad precedents, loose methods or improper management, was equally unwarranted either by the facts or the testimony. The Commissioners were careful not to give many details for this charge but contented themselves with the general statement. It is believed that this statement will show wherein the facts concerning each of the items comprising this amount are quite different than would appear from the reports, and that the charge is completely met and successfully refuted, barring a very few isolated cases where oversight or incompetency have had the usual result. Experience shows that absolute perfection was not attainable in work of this magnitude, yet it is believed that the total amounts improperly spent for these reasons on this work do not equal the cost of its investigation.

After a most searching and biased inquiry, with the testimony brought out by one side only and no cross-examinations, all the charges that can be made affecting this department rest on no better foundation than a misunderstanding of facts and laws and differences of opinion which may or may not be thoroughly honest.

LOCK IMPROVEMENT.

The statements in both reports relating to the subject of lock improvement are other instances of carelessness in both reports and involve a considerable number of misstatements, misapprehension of facts, and incidentally of some poor judgment.

On page 12 of the Commissioners' report the statement is made that the contemplated improvement did *not* include the improvement of the Lockport locks and the "Sixteens" at

Cohoes. That is a deliberate misstatement, for the law contains no exception and was absolutely mandatory. By way of explanation it may be said here that all the locks on the Erie canal, except those at Lockport, Newark, Little Falls and Cohoes, have already been lengthened to double boat length, excepting also all locks below Cohoes, which form the outlet from the canal to the Hudson river, and which it is not necessary or advisable to lengthen, because at those points it is not necessary to pass more than one boat at a time because all fleets are usually broken up at these points in making up the river tows. The reason for leaving until this time the improvement of the other locks mentioned is, that their improvement can not best be effected in the ordinary manner, because of their peculiar location and surroundings. At Lockport, for instance, it would be physically impossible to lengthen the present locks in the usual manner during the season of closed navigation, and to so lengthen them would surely necessitate the closing of the canal for one season. This certainly would not be tolerated. We, therefore, began the study of other types of locks, and have found the subject a very interesting and difficult one, though promising most satisfactory results in every way. It was found that several varieties of what we call "machine locks" to distinguish them from the old form of masonry locks, could be built at both Lockport and Cohoes, so as to accomplish the object of the improvement for very much less money than would be required under the old method. Lockport was believed to be the best place to build the first of these locks, because the location permitted the building of the new locks without in any way interfering with traffic through the old locks, which need never be destroyed, and would always remain as a safety valve in case of the possible failure of the new lock during what might prove to be its experimental stages. It is evident from the language of the reports of both the Commission and its engineers that this feature at Lockport was not understood. Proof of this is to be found in their recommendation that the first of these locks be built at Newark to

replace the three existing locks there which are now on a bad curve, which is easily susceptible of realignment, with whatever form of lock may be adopted. Here the old locks could be used the same as at Lockport until the new lock was in perfect working order. The situation, however, is radically different than at Lockport, because at Lockport the building of the machine lock is economical, while at Newark, such a lock would cost over \$200,000 more than the two contemplated ordinary locks, without effecting any appreciable saving in any other direction. We, therefore, long ago concluded that the building of such a lock at Newark would be an inexpedient and unwarranted undertaking, the great cost of which could not possibly be justified, especially in view of the fact that all the conditions which lead the Commission and its engineers to suggest this place as the proper point for the first installation, exist also at Lockport. So far as the Commissioners' charge (see page 38), that \$49,391.32 was improperly expended for the plans for the Lockport and Cohoes locks is concerned, it should be stated that at the time these plans were undertaken, we had very good reasons to believe that the amounts of other work to be done could be so reduced as to leave sufficient funds available for these locks. In fact the estimates at contract prices at that time showed that practically one-third of the whole work was contracted for for one-third of the available sum. After much study on the subject it was believed that at least three types of locks were available, and since none of these ever had been built, it was thought best in order to reach an intelligent conclusion on points of comparative efficiency, as well as cost, to prepare plans of each type of lock. The matter was, of course, a serious one, involving a considerable expenditure for plans, but it was so full of promise in various directions that we decided to go ahead, providing the approval of the Canal Board could first be had. The matter was thoroughly discussed at a Canal Board meeting when the Comptroller, Attorney-General, Superintendent of Public Works and State Engineer were present, and their opinion was that the

work was proper, and it was accordingly started. Over two years' conscientious study by the officers of this department and other capable engineers have been devoted to this subject, and it is believed that the plans that have been prepared and submitted for the Lockport locks are well-nigh perfect, and that no serious points that would effect a satisfactory installation have been overlooked. The Commission's engineers seem to suggest in a vague sort of way that the plans for other machine locks, which have been built in France and Belgium, might have been adopted here in preference to the proposed plans. Further study into the subject would probably convince them as it has us of the almost impossibility of such a course, because the needs here are for a lock of more than double the length and weight of those they have in mind, and they forget that some designs are only economical within certain well-defined limits.

These facts are not, however, mentioned in either of the reports which also carefully avoid any mention of the great savings of time and money that could be effected by building the proposed locks. Was this feature unworthy of comment? The situation at Little Falls has also been carefully studied, but the problem there is a difficult one. A variety of plans could be adopted, each of which would be an improvement over the present situation. A proper determination of the comparative cost and desirability of these several plans will involve a considerable sum of money for preliminary study, and as the work has progressed, and it has been seen that funds for the construction could not be available, further studies at this point have been dropped. It is certain, however, that the statement on page 12 of the engineers' report that the cost of pneumatic or machine locks, at Newark and Little Falls, would either "expedite traffic or economize the cost of construction" is *grossly* erroneous. As a matter of fact such locks in either location will cost nearly or more than double those which have been contemplated by the present canal officials, while the saving of time would not in either case exceed fifteen minutes. Such a slight saving does not in any way benefit canal traffic, and the expenditure of hun-

dreds of thousands of dollars to attain it would, therefore, be decidedly "improper."

An important point connected with the lock improvement problem seems to have been overlooked. The object of this whole improvement is not solely the renovation of the canals for the sake of the renovation, but its aim is to make it possible to handle larger cargoes. That would mean lower rates and unquestionably a sufficient increase of commerce to make the outlay a paying one both to the State and to the boatmen.

An enormous volume of commerce has been drifting away from us. It is being diverted by modern competing routes to points outside of this State. We seek to reclaim it. That can only be done through the medium of increased speed or increased cargoes. The first is admitted to be not feasible, unless at a great waste of energy, because of the limited cross-section of the canal and other reasons, while the latter is easy of accomplishment and will surely follow the completion of this improvement. More time than is now consumed will be required to handle the increased cargoes. It is now barely possible to make seven round trips per season.

The larger cargoes must be handled in the same time or the improvement is of no avail. How shall we save the difference in time? The proposed Lockport and Cohoes locks offer the solution.

Another important point is the great saving in maintenance and operating expenses that these proposed locks would make possible. At Cohoes alone this would amount to over \$45,000 annually, while the further saving of water which could be used by the Cohoes mills would be of inestimable value to thousands of people.

BERME SLOPE WALLS.

The next adverse criticism of the Commission's engineers relates to slope wall on the berme bank (pages 12 and 13.) The statement is made in such a general manner as to lead to the conclusion that large sums of money had been wasted by the present officials in building slope walls. As a matter of fact, very little new slope wall has been built on the berme side, and

then only where it seemed absolutely necessary in order to maintain the banks. The extent of this work was as follows:

	Length (miles).	Cost.
Eastern Division	0.00	0.00
Middle Division	10.02	\$102,500
Western Division .....	.495	8,117
Totals	<u>10.515</u>	<u>\$110,617</u>

NOTE.—The length of canal under contract is 300 miles.

On the Eastern Division no new slope wall has been built on the berme side, but a small amount of "wash wall" has been built to protect short lengths of banks at three culverts and along a street in the city of Schenectady.

The marl and quicksand on the Jordan, Port Byron and Montezuma levels made some kind of wall a necessity, hence these figures for the Middle Division.

The balance of the work has been in underpinning and topping out old walls for the existence of which or the wisdom of their construction the present officials can not possibly be responsible. Since the walls were in existence, but one of two things could be done, either they could be underpinned and saved, or they could have been torn out, leaving the earth slopes as recommended by the Commission's engineers. Does any one believe that the latter course would not have led to merited censure?

Patchwork repairs, as applied to these walls, must be done to match the old structure, and the form and extent of the latter may, therefore, under all circumstances, preclude the possibility of improving the design as in this case.

WATER SUPPLY AND SURPLUS WATERS.

Considerable space is given to the question of water supply and the use of surplus canal waters, but except the fixing of the grade of canal bottom to a depth greater than nine feet from theoretical water surface at the head of the Lockport locks, all that has been said on this score affects the Department of Public Works and not this Department. That the situation in this respect could be im-

proved under certain conditions is not to be doubted, but it would only have been fair to admit that part of the trouble is and always has been beyond the control of the Canal Commissioners, the Canal Board, and more recently of the various Superintendents of Public Works. This Department has called attention, time after time, in its annual reports to the existing conditions and recommended remedial action. That is as far as this Department has any authority to proceed in this connection.

With the whole question of water supply on the Western Division, reference should be had to pages 173 to 222, inclusive, of the State Engineer and Surveyor's annual report for 1896. The adoption of the grades west of Lockport was based largely on the special report by George W. Rafter, C. E., member of the American Society of Civil Engineers, contained in the pages above referred to. To assume that the extra depth above Lockport which they say has or will cost \$125,000, was entirely for the benefit of the milling interests at Lockport and along Eighteen Mile creek, is not a fair statement and is not founded on facts. The primary object of the thirteen-foot channel in the narrow rock cut above Lockport was to avoid excessive currents and provide sufficient feed water at all times for the sixty-two mile level between Lockport and Montezuma, on which portion it has always been difficult to provide sufficient water to maintain navigation at all times, even when all the waste gates, including those at Eighteen Mile creek, were tightly closed. This is due to the fluctuations of water surface of Lake Erie. In fact, boats were stranded along this sixty-two mile level in question during the last days occupied in the preparation of the Commissioners' report, namely, on July 10 and 11, 1898. The same condition also existed several times during the month of August, 1897. It, therefore, followed that exclusive of the question of providing water for milling purposes, a larger proportionate part of it must be provided strictly for navigation. In other words, the cross-section of the canal prism in the long narrow rock cut just west of Lockport must be increased to a greater extent than the cross-section east of that line. The question of the disturbance

of the old silted bottom of the prism, undoubtedly involving greatly increased filtration, had also to be considered, and it has not yet been proven that the adopted cross-section is even sufficient to provide the water that will be needed strictly for navigation. That the reverse may be true is easily possible.

If the canal through the rock cut mentioned were as wide as the other portions and had admitted the passage of sufficient water under the old conditions, then it would only have been necessary to increase the cross-section through this rock cut to the same extent as was done on the other portions, but that was not the case and the omission on the part of the Commissioners to so state it leads to erroneous impressions and adverse criticism. The cross-section could be increased only by widening or by deepening. If by deepening, every foot of excavation added to the cross-section; if it had been done by widening, an enormous portion of rock excavation would have been required above the water line, since the walls of the rock cut are from fifteen to thirty-five feet high and extend along a distance of about three miles. It can not, therefore, be conceded that improper work was done or even poor judgment used in locating these grades.

The statement that all the water used at Lockport is returned to the canal will bear repetition, and the fact that the temporary diversion of this water has, without being in any way detrimental to the State, been the basis of the growth of a large and prosperous city, on the valuation of which the State collects large sums annually in taxes, is the reason usually advanced why the State should allow the use of such water for a nominal consideration. It does not, however, follow that any company should be given a monopoly of this water privilege at the expense of the other consumers.

The situation at Eighteen-Mile creek, to which reference is made, is radically different because any water taken from the canal at that point is never returned. A spillway at this point is an absolute necessity. The surplus waters at this point pass through an opening in the bottom of the canal so as to avoid

side draught on the boats. The water then rises into a forebay, the walls of which form a spillway at the same elevation as water surface in the canal. Its operation is thus far really automatic. However, this section of the canal is subject to considerable fluctuations of water surface, and in order to control these fluctuations, it has also been necessary to introduce a series of gates into the walls of the forebay. If these gates are honestly attended to by the person appointed for that work by the Superintendent, then the State can not suffer. To select men who will tend these gates conscientiously seems to have been one of the great troubles in this connection throughout the entire length of the canals since their construction.

PROPOSED CHANGES OF ROUTE.

A considerable portion of the report of the Commission's engineers is devoted to proposed changes of route along all three canals embraced in the improvement under discussion. It is certain that the location could have been improved in many places when the canals were originally built, and some, if not all, of the suggestions made toward that end, at least deserve careful consideration, but it is a subject wholly beyond the scope of the mandatory laws which direct the present improvement and in the preparation of which, strange as it may seem, the canal officials had no voice whatever. Some of the suggestions are by no means new and some of them are practically impossible of accomplishment for political and economic reasons. The canals were not built, are not maintained and will never be changed on purely scientific or engineering reasons. The whole canal question is viewed in such different lights from the different sections of this great big State, that it has always been and always will be necessary to compromise on all canal matters. It is a matter of history that some of the lateral canals, some of which have been abandoned, some of which are still used as feeders, and practically all of which have never produced returns commensurate with their cost, were purely matters of "log rolling" and compromise in the Legislature. Glaring examples of the unwisdom

of this course are to be seen in the location of the canal between the upper and lower Mohawk aqueducts, where the Mohawk river is needlessly crossed twice with very expensive aqueducts, simply to get part of the canal into Saratoga county. Another such example is the building of an artificial canal on the very banks of the Hudson river between Watervliet and Albany, a distance of about four miles, including the unnecessary building of Erie locks Nos. 1 and 2 and two locks at Port Schuyler side cut. Albany county's legislators were responsible for this waste in the beginning and they would probably protest most earnestly and probably successfully against the closing of this portion of the canal if it were suggested now. The canal officials have appreciated that the unsatisfactory physical condition of the canals and other conditions incident to traffic thereon were rapidly robbing this State of a vast amount of valuable commerce, and they, therefore, conceived it to be their duty to proceed with the work authorized with all possible speed, making the best of the conditions as they existed, and not confusing the subject with all sorts of new schemes which might and doubtless would have delayed the whole project for many years. In fact many well-informed people argue that the constitutional prohibition against abandoning any of the canals would affect the proposed changes. Most of the suggestions made by the Commission's engineers have, with greater or less modification, been discussed for years. The whole subject, however, is entirely foreign to the present improvement and need not be discussed at greater length here.

SPECIFIC CRITICISMS OF SPECIFIC CONTRACTS.

Eastern Division, Contract No. 8, on Champlain canal at Waterford.—The Commission has probably devoted more time during the investigation and more space in the report to this than to any other contract. It involves questions of unbalanced bids, embankment or "overhaul" classification, extra work due to breaks, and a conflict of judgment between the resident engineer and his superior officers.

That it has afforded opportunities for adverse criticism can not be disputed, but so much information has been given to the Com-

mission both in and outside of the sworn evidence about the reasons and conditions connected with the contract that it was only reasonable to expect that fair mention thereof would be made in the report of this supposedly impartial Commission. They do not state the case fully or fairly. Whalen and Higgins were the lowest bidders on this contract on the basis of the bidding sheets. All of the prices were reasonable and in fact low for each of the items except "embankment," for which the bid called for eighty cents per cubic yard. The contractors were known to be men of ability and energy, and as a matter of fact, they showed this by completing their contract ahead of any of the others. It unfortunately happened that unless spoil banks were provided for a large portion of the excavated materials, they would have to be hauled more than 1,000 feet, and, therefore, be paid for also as embankment at the high price named. This was the only questionable feature of the bid. After due consideration, the State Engineer assured the Superintendent of Public Works that such spoil banks could and would be acquired, and that, therefore, the quantity of embankment shown in the bidding sheet need not be exceeded. Had that been done and the work carried out according to instructions, the bid would not have been an unbalanced one, and as a matter of fact the contract would have been completed for \$10,406 less than the engineer's estimate on which the contract was based. This does not take into consideration the cost of breaks, which would have been extra work under any circumstances.

In order to carry out the promise made to the Superintendent regarding the spoil banks on this work, the State Engineer, Deputy State Engineer, division, resident, first assistant and assistant engineers all were on the ground together soon after the contract was awarded and selected such spoil banks as could be made available. The most positive instructions were then and there given by the State Engineer, and all testimony agrees on this point, that the quantity of embankment or overhaul for which the excessive price was named in the contract, should not, under any circumstances, be exceeded. Instructions were also given at the

same time, providing for the surveys of these spoil banks that had been selected, and they were afterward duly acquired by the State in the manner prescribed by law. The Commission's statement (page 23), that these were not acquired, is an error for which there is no good excuse, for they had full information. The use of this land for the purpose intended made it necessary to remove quite a number of buildings which could not be touched until the land had been acquired. The best information at that time was, and it is susceptible of proof to-day, that these spoil banks, which were all that could be made available, would not accommodate all of the surplus material, and that about 5,000 yards (the bidding sheet called for 5,640 yards) must necessarily be hauled more than 1,000 feet to some place of deposit, and, therefore, be paid for also as "embankment." There is a culvert on Second street, in Waterford, which the State recently rebuilt, but the appropriation for the work did not suffice for sufficient grading to properly complete the work, which is on the principal street, leading to the Delaware and Hudson railroad station.

The work in its unfinished condition was an eyesore to the citizens, and on their suggestion it was finally agreed that the material which must necessarily be paid for as embankment, under any circumstances, should be hauled to this point and used to complete the proper grading of the street. The contractors were taking advantage of the fine December weather to complete their excavation before frost interfered, and therefore had a large force of men and teams on the work. The spoil banks were not yet available for his use, though the efforts to make them so were being pushed. In fact a special corps of engineers was detailed to make the surveys therefor, in order to save time. All of the material that could be disposed of within the 1,000 feet limit of haul had been excavated, and unless the contractor could proceed to take the 5,000 yards, or thereabouts, of surplus material to the above-mentioned culvert, he would have been obliged to suspend work and disband his forces then engaged in excavating until the spoil banks were made available. At that season of the year every day of fine weather, which then obtained, was of great value to the contrac-

tor, and there seemed no reason why he should not profit by it. Resident Engineer Himes had, however, directed that no material be hauled to the culvert until the spoil banks had been filled. As the figures of the assistant engineer in charge (now Resident Engineer John G. Tait) indicated, as has been said, that there would be 5,000 yards of waste material available for use at the culvert, this seemed like an unnecessary interference with the operations of the contractor, and on protest by the contractors, Mr. Himes' decision was overruled by the Deputy State Engineer in a letter, which is quoted on page 91 of the Commissioners' report. The letter seems to be clear enough in view of the fact that all of the conditions, as above stated, were well understood by Mr. Himes, Mr. Tait, and all of the other engineers.

Complaints regarding the unwarranted interference with the contractors' operations at numerous points by Mr. Himes were, at that time, frequent occurrences, and were the subject of comment and sometimes ridicule in the division engineer's office, with which he was connected. He had frequently been counseled against such a course by the various engineers in the State and division engineers' offices, unless the very best of grounds could be shown, as otherwise it might be reasonably expected that such interference would form the basis, as it frequently has, of litigation to enforce claims for damages because of unwarranted and unjustifiable delays. That there was friction on this account between Mr. Himes and the other engineers was well known, and the fact is that he rebelled against what he regarded as being overruled, and paid no further attention to this feature of this contract. His unjustifiable interpretation of the orders he received from the Deputy State Engineer led to the placing, not only of 5,000 yards of waste excavation but of all the remaining excavation in the vicinity of the Second street culvert, instead of on the spoil banks, as was expected. The entire work was finished in a very few days, and when called upon to show why the spoil banks had not been used as planned, he seemed to be quite as surprised as his superiors to realize that it had not been done and that he had allowed the work to run away from him. Not a yard of material was placed on

any of these spoil banks, and they were afterward abandoned by formal action of the Canal Board.

The whole deplorable situation was due to Mr. Himes's neglect, part of which was caused by pique, and part from another cause which should be mentioned to show the characteristics of the man. Prior to this time, he had asked the State Engineer's permission to enter the Albany Law School, using such spare time as he might have in that line. He was told that it was certain that his duties as resident engineer would require all his time and energies, and that he would be called upon to resign if he began the study of law as contemplated. That, he said, he did not care to do and the matter was supposed to be closed, but the records of the Law School show that he did enter as a student on September 22, 1896, and that he continued his studies during the term of 1896 and 1897. His mind was principally occupied with his law studies, his text-books being carried about with him on the trains, and it has since been learned that during a good portion of the time he was pursuing them, his field-work was done largely over the long-distance telephone, because he could not well be at the Law School and in the field at the same time. He was, however, very careful to see to it that his legal studies were unknown to the State or Deputy State Engineer.

Closely following the trouble over this "embankment" at Waterford, came other trouble connected with breaks on the same contract, the total cost of repairing which was about \$16,000, a large part of which was chargeable to a lack of experience and judgment of this same Mr. Himes. The towpath bank from the Delaware and Hudson railroad bridge, about a quarter of a mile northerly, has been leaky for over seventy years, due to faulty original construction. One night in the spring of 1897, part of the excavated material that had been placed outside this towpath bank began to slide. The trouble was solely due to the thawing of the new bank and the deep layer of muck on which it rested. *The old bank remained intact.* Mr. Himes was called at 2 a. m., and went immediately to the scene. Numerous engineers and canal officials heard stories of serious trouble there on their arrival at their

offices the following morning and they also went to investigate. They found that Mr. Himes had ordered a long trench dug through the middle of the towpath, which was to have a double row of sheet piling driven along its entire length and afterward be filled with puddle. A large force of men were at work and the work had progressed so far that there was nothing left to do but finish what was then nearly done and order no more to be started. The excavation in the towpath showed it to be hard and perfectly dry down to five feet below canal bottom, or for a depth of fourteen feet.

Everybody but Mr. Himes realized that a very serious mistake had been made by thus cutting the towpath into two disconnected parts, the outside part of which afterward began to slide and had to be protected at considerable expense. Other instances of this lack of judgment were frequent at the time and were at least partially responsible for his resignation.

His clash with the State Engineer over a matter of classification on Gallo & McNiece's Eastern Division Contract No. 4 is a case in point, which the Commission has not failed to notice, and, of course, criticise. Here Mr. Himes' judgment was opposed to that of the first assistant, division and State engineers, and careful records, which showed that the material in question was actually costing \$1.86 per yard to excavate with good management. The contract price for rock was \$1.25. To get fair treatment the contractors were forced to appeal to the State Engineer, whose decision was backed by the opinions of the division and first assistant engineers, both of whom are men of large experience. His motives during the investigation should, therefore, be apparent. The Commissioners were fully aware of all these facts and might reasonably have considered them fairly, but instead they felt called upon to say, page 84, "if instead of such support they are snubbed and overruled when too active in enforcing the rights of the State, the result is demoralizing. So far as we have learned, the only instance in which the engineers have been brought in collision with the heads of the Department occurred in cases where they were too tenacious of the rights of the State."

The case of Assistant Engineer John C. Wait is another in point, though his authority was confined to the specific work to which he might be assigned. He was asked to resign, because the alternative was the resignation of the first assistant, resident and division engineers of the Middle Division, who had tolerated his erratic conduct, disobedience of orders and generally troublesome makeup on this and other State work until "forbearance ceased to be a virtue." His testimony, however, has been exploited by the Commission to the exclusion of much important matter that might have been added to its advantage and that of the canal officials.

It does not now seem desirable from any standpoint that we should attempt to answer all of the criticisms that have been made. Some of them are not of sufficient importance to justify an explanation, and the more important of them are covered by what has been said in the foregoing statement. Page after page might be written to show that a very great many of the criticisms are not based on either the facts or the evidence, and that many of the figures submitted in both the reports are erroneous. In fact, there is hardly a table or statement where figures are used that is correct. The table of mileage completed is a case in point, and does not give the canal officials fair credit for the work that has been accomplished.

Another instance of this careless handling of figures of so much importance is to be found on page 7 of the abstract of the report prepared by the Commission, where, on page 7, it states "the cost of hardpan classification, including shale, on Western Division, is \$291,277." This was unfair to the canal officials, because the statement has been published broadcast, and the inference is that the other divisions had spent about the same sum for classification. The facts are, however, that the sum mentioned covered the entire cost of classification on all three divisions and all three canals.

On page 84 of the Commissioners' report the details of the statement are given, and to illustrate again this careless use of figures, we desire to state that only one of the amounts in that table is

correct, but even though they were all correct the table has an error of \$9,000 in addition. The correct figures will be found in the table given in this statement.

Some of the criticisms are almost ridiculous and they also need not consume much time, but it seems proper to cite a case in point. On the first page of the engineers' report they say: "We think that the specifications for masonry are defective in that they called for headers only thirty inches in length, irrespective of the rise of the stone." They did not say which class of masonry this refers to, but as the specifications for all other classes, except the vertical walls, distinctly calls for headers much longer than thirty inches, they must refer to the vertical walls. These are from two to two and one-half feet thick on the top, six feet on the bottom and eleven feet high. A thirty-inch header will, therefore, reach about halfway through the wall at any point and entirely through the wall for a good portion of its height. Moreover, thirty inches is the minimum and not the maximum length. Such criticisms only serve to indicate the desire to find something to criticise. There are, however, a great many criticisms which are deserving of attention. These refer to specific things on specific contracts. The discussion of these begins on page 46 of the Commissioners' report and continues up to and including page 83.

EASTERN DIVISION.

NOTE.—In order to avoid tedious quotations, only the substance of the criticisms contained in the reports of the Commission and its engineers are herein given. A complete understanding of all the questions would be facilitated by reading those reports in connection herewith.

The remarks on page 46, relating to contracts Nos. 4, 30 and 6, and on page 49, regarding contracts 5 and 6, relate to misunderstanding of instructions and errors and omissions by the assistant engineers on those contracts, which were not discovered in the offices of either the division or the State Engineer prior to awarding the contracts. That they should have been discovered can not be denied, but the only result, except on the Western Division contract No. 5, has been the payment for the increased quantities, and as these were at contract rates, which were fair and equitable, the State did not suffer. Moreover, the Commis-

sion does not charge that it did suffer, except as stated on contract 5. This will be considered later herein.

On page 63 some unfair statements are made regarding classification on contract 10. Concerning this work, Resident Engineer Tait says: "I felt justified in making the classification, because for some reason there was a strong feeling entertained against this contractor by Mr. Himes and Mr. Warner (then assistant engineer), and it looked to me as if this feeling had affected the dividing line between earth and rock to the contractor's loss."

Referring to the statement on the same page about a piece of this classified material becoming soft mud on being immersed in water by Mr. North, Mr. Tait also said:

"There is no way in which I can answer this 'gallery play' of Mr. North's other than to say that it was actuated by the same spirit of unfairness and misrepresentation that characterizes the whole report. If there is such a material as hardpan, that sample was from it. When it had been soaked in water and worked down it became dissolved into 'gravel, clay and sand,' using Mr. North's own words. On reference to the Century Dictionary, it will be seen that these are the materials specified in the definition of hardpan.

"On this contract occurs also 10,000 cubic yards of laminated clay, which is hardpan, but which I have not classified as rock, although under the conditions existing on this contract I think an equity allowance might be justifiable. My reason for not classifying this material, though it was expensive to handle, was the fact that when wet or moist it can be spaded."

Contract No. 2.—The criticisms regarding classification on contract No. 2, as stated on pages 64 and 65, lead to unwarranted inferences. Boulders of less than half a cubic yard in volume should not be paid for as rock, but the case is not stated fairly. There is no material on the canal that cost more to remove than this particular excavation. It shows to-day nothing but boulders, whole and broken up, and the material in which they are bedded in hardpan by itself. The report does not say that it was not, but creates the impression that the classification was

wrong by mentioning that boulders of less than one-half cubic yard were paid for as rock, which, of course, would have been wrong had the stones been loose or separate.

Contract No. 4.—Pages 65, 66, 67 and 68 refer to Gallo & McNiece's contract No. 4, where it is claimed that the State Engineer compelled the resident engineer (Mr. Himes) to classify part of the material as rock against his judgment.

The contractors claimed that they were excavating hardpan and asked to have it classified as rock under the terms of the specifications. The State, division, resident and first assistant engineers went up to the work, examined the material and all agreed that it was hardpan. The State Engineer directed the resident engineer to classify $37\frac{1}{2}$ per cent. as hardpan—that is, classify the 25 per cent. on top as earth and one-half of the balance as hardpan, *if it was found that the material could not be plowed after a test had been made.*

The report says on page 68: "There was no proper attempt to plow the material. It was excavated by a steam shovel." Both statements are absolutely false. The resident engineer tried to plow it, *as he testified.* Eight horses and as many men as could get hold of the plow were used in the attempt; but it was found to be impossible. The material could not be plowed and every yard that has been classified, and more too, was actually blasted, and that was the cheapest way to remove it. The statement that it was excavated by a steam shovel would lead to the inference that if the shovel could dig the material, it might be plowed, but, as a matter of fact, *no steam shovel was ever used on this or on either adjoining contract.*

After having tried to plow the material, Mr. Himes directed Assistant Engineer Cornell to cross-section or measure *such material as he pointed out as hardpan.* The material thus measured amounted to 7,500 cubic yards, which Mr. Himes reduced to 6,000 cubic yards, though by what process he arrived at that conclusion we are unable to state. Mr. Himes' assertion that he was directed by some one higher in authority to make such an estimate is absolutely false. The only directions he received

were those given by the State Engineer on the day the examinations and tests were made.

The price for rock excavation on this contract was \$1.25, and as proof that the material was not improperly classified, it may be added that careful records of the cost made at the time in anticipation of a dispute, showed that the actual cost to the contractor was \$1.86, exclusive of the use of explosives and tools. In other words, the actual cost was one and one-half times what he received. It is claimed that the work was done at a loss of \$16,000.

Contract No. 5.—The remarks on pages 68 and 69, regarding Contract No. 5, criticise the amount of classified material and the method of determining the amount. How it would be possible to measure *under water* a line of demarcation between earth and hardpan is not clear. The earning capacity of the dredge seemed to be and was the best and only guide.

The facts are that the material was very hard and the dredge was only able to dig a small amount at each operation. The fact that the dredge was able to *dig any* amount does not indicate that the material could have been plowed. Bear in mind that when the dredge was working the material was wet, and that the dipper arm has sixty horse-power of steam behind it. Dredging was resorted to only after attempts had been made to plow the material, under the supervision of Assistant Engineer Trumbull, Resident Engineer Tait and the contractor.

Contract No. 19.—On pages 69 and 70, Contract No. 19 comes in for several criticisms, neither of which is based on either the facts or the sworn testimony. On page 70, first and second lines, they state that material that had once been returned in the estimates as earth was afterward transferred to the rock column. The sworn testimony of Acting Assistant Engineer Van Loon shows that prior to the estimate in which this appeared as rock, it had never been included in any estimate, but had been held awaiting the decision of the resident engineer.

In considering the excavation of this material by a steam shovel, the power applied to the dipper arm should again be

borne in mind, though the Commissioners say that the material was blasted ahead of the shovel. It was in fact so hard that the attempts to excavate it kept the shovel broken down a good share of the time.

Regarding the inverted arch in the bottom of the canal, the shape of which leads the Commissioners to think that the portion near the banks was nothing but silt deposited by the propellers, it is important to refer to the sworn testimony of Resident Engineer Tait, which shows that in places where hardpan was encountered, the old canal was not originally built to the full prescribed cross-section of prism, and that large quantities running as high as four feet above canal bottom, at the toe of the slopes, had never been excavated. This is true on all of the three divisions.

Contract No. 7.—On page 98, the statements regarding some “lining” material used on Contract No. 7, show how half-truths can be made to indicate improper methods. The whole truth regarding the matter is as follows: During the spring of 1897, a considerable portion of the towpath on this contract sloughed off, after navigation was opened. Leakage had weakened the entire bank. The other work on the contract was completed, but this break had to be repaired.

The situation demanded the use of as heavy material as could be found in order to weight and hold the balance of the bank. This had to be “borrowed” from some point outside the work, as the work was done and water in the canal.

Investigation made personally by the State Engineer, with other assistants, showed that the bed of Fulmer creek was the nearest point where suitable material was available. This was over a mile away. This creek needed cleaning out above the aqueduct under which it passes, and the material was ideal for the purpose intended, being almost entirely of small stones. Under all the conditions it seemed a fine opportunity to “kill two birds with one stone” and the work was ordered done. By using this material we avoided drawing off the water and delaying navigation; we saved a bad break, and we secured the cleaning of the creek, so as to insure the aqueduct against floods. So

far no one doubts the wisdom or propriety of the work as done, but the "hitch" seems to be in the matter of compensation. Bear in mind that all other work on the contract was completed, though not yet accepted, and that the length of haul was one mile, over the poor roads incident to the season of the year; that the material had to be hauled up out of a creek-bottom and over a steep bridge approach, using four horses to each load. For the excavation, removal and deposit of this material, the contractor was paid sixty cents per cubic yard—the contract price for "lining." The question is, whether or not the specifications justified this payment under the conditions. The lining specification says: .

"Under this specification is to be included all the gravel, broken stone, or such other selected materials as shall be approved by the engineer, to be placed, when directed, in foundations of structures, behind walls, or on the top of embankments, lining prism to prevent leaks, and such other places, and to such extent as the engineer may direct."

This would certainly seem to justify the course that was pursued, and that course is the same as is now and always has been pursued, under similar circumstances, on canal work. It is frequently difficult to decide as to the difference between "excavation and embankment" and "lining." The contractor, as well as the State, must have fair treatment. In this case the contractor demurred against doing the work at the price of either "excavation and embankment" or "lining" and demanded that he be paid for the work on the force-account basis. This was partially due to the fact that his other work had been completed, and his forces disbanded. At sixty cents per yard it would be necessary for teams to make ten round trips per day, or twenty miles, in addition to the time required for loading or unloading, before the contractor could get any profit from the work. Fairness to both parties must be considered.

The closing sentence, on page 70, referring to the eastern division, that "Generally speaking, there were no actual tests made on the eastern division to determine whether the material could

be plowed or not," is a slur against the intelligence and honesty of the engineers and inspectors generally, and was not justified by the facts or the testimony, for where there was any question, actual attempts to plow have been made, but it does not follow that it is necessary to actually make the attempt in cases where it would be apparent to any one that such attempts would surely prove fruitless. If that is not true then the contractors should be compelled to try a plow in every piece of slate or even of ledge rock that might be encountered. The criticism is made with a too evident desire to find fault indiscriminately.

MIDDLE DIVISION.

On page 70 the manner of computing a quantity of excavation that was classified as rock on Contract No. 1, is criticised. It is not asserted that the estimate as rendered is in error—only the method of arriving at the result is criticised. The bare facts are all as stated, and the further fact is that the State's interests were well protected.

The contractor demurred against the allowance made, but there was a doubt and the State got the benefit of it. The resident engineer says, "The probabilities are that we only allowed him 60 per cent. of what he was actually entitled to. The engineer in making up his final estimate showed the cross-sections for this work as he had estimated the quantity and made a note giving his reasons for doing so. This was explained to the Commission."

The assistant engineer had been told to allow rock up to station 50. The excavation actually proceeded to station 55 in the same class of material, and when the decision about allowance was made, the canal was flooded and no measurements could be taken. Evidently the Commission would have taken advantage of a technicality and underpaid the contractor rather than acknowledge an error.

Over \$85,000 worth of claims on this contract, each having more or less merit, have been denied by the State Engineer, but from reading the reports of the Commission and its engineers,

one might infer that all a contractor had to do to get money was to ask for it.

Contract No. 2, pages 71 and 72.—Assistant Engineer Lee made the surveys and estimate for this contract. The ledge rock disclosed by the survey was the only rock included in the bidding sheet, though his notes showed a large portion of hard material which might require classification. As its hardness could not then be determined, it was included in the bidding sheet as "earth." A large portion of it has since been classified as "rock," and the Commission thinks this improperly done. Their statements of the quality of the material and the attempts made to plow same are, however, not according to facts. Owing to the well-known friction between the resident engineer and Assistant Engineer John C. Wait, who was afterwards assigned to the charge of this work, extraordinary care was used in deciding all matters about which there could be a difference of opinion. The Commission fully understood that Mr. Wait had been asked to resign; that he afterward tried to injure the reputations of the resident, division and State engineers by questioning their honesty and motives in a letter written to the Comptroller, and that he tried to have the Comptroller deny payment on the estimates for this work, the correctness of which he (Wait) had previously sworn to. He also threatened in a letter to the State Engineer to force his reinstatement through the courts. His testimony was, therefore, that of a "sorehead," and should be treated accordingly.

Contract No. 3, page 72.—The remarks made in the preceding pages of this statement regarding excessive quantities, classification, and what the Commission term "reclassification" seem to cover the criticism here made. It is believed that all due care has been exercised in these matters and that the State has value received for every dollar expended, and that the work has been done and paid for strictly in accordance with the specifications.

Contract No. 4, page 72.—If there was any material excavated on any of the canals that was properly classified, it was on Contracts 4 and 5. The report says, "It was loosened by picks and

excavated with shovels." As a matter of fact, it was blasted, and then picked and shoveled. The most of it was cemented gravel and it could not be plowed by any device. Its formation is very irregular. It runs from the grade of canal bottom to depths forty feet below the towpath and the direction of its ridges and hollows change very suddenly. Sometimes these run longitudinally with the canal, sometimes diagonally and sometimes at right angles. The material over this hardpan in some of these depressions is quite soft, and it is into this material and not into the cemented gravel that piles can be driven.

Contract No. 5, page 73.—This contract is in most respects similar to No. 4. The Commission asserts that "a portion of the material classified as rock on this contract was actually plowed in excavation." Our engineers, however, assert that none of it was plowed. What the Commissioners say in numerous places about quantities of classified material not being actually measured should be taken with several grains of salt. It is not always an easy matter, and sometimes it is almost impossible, to get exact measurements of these quantities in the precise manner which the Commission seems to think the situation requires. However, each of the engineers fully appreciates that he must take an ironclad oath regarding the correctness of his work, according to the best of his information and belief, and it is hardly reasonable to expect that this oath is regarded as lightly as the reports would seem to indicate. They may not have the figures and measurements with absolute precision, but they are well informed as to the quantities handled, and the margin of error one way or the other is no greater than in similar cases on all other public works.

Contract No. 19, page 74.—This is another case of the criticism of methods instead of results, and since they say "substantially the whole of the material classified on this contract was cemented gravel and hardpan," the matter does not seem to call for any comment.

Contract No. 23, page 75.—The material classified as rock on this contract was actually rock, and was almost hard enough to

be used in building slope walls. The assistant engineer should have included it in the estimates as rock, but simply had not done so because the resident engineer had not passed on the matter.

Contract No. 25, page 76.—The 500 yards reclassified here by direction of the resident engineer was known by the assistant engineer to be hardpan, but was not included in the estimates until the resident engineer gave the direction. Part of the material was actually blasted and the remainder was picked—at an expense equal to blasting—because the residents in that vicinity objected to the blasting, and because the blasting endangered the vertical walls, which, in that vicinity, were of very poor quality. The material in question was a hard shale rock.

Contract No. 26, page 74.—Speaking of the allowance of classified material on this contract, the Commissioners' report states that "the contractor was allowed two feet above grade," or all the material between old and new bottom. The Commission misunderstood the testimony (see page 3159). The depth was one foot instead of two feet.

The report frequently says that classified material was actually plowed. That, however, is not true to our knowledge. The testimony of Assistant Engineers Thomes, Brown, Briggs and Olney was cut short by the Commission's counsel regarding plowing. When they stated that material had been plowed, *after blasting*, skillful efforts were made to turn their statements so as to indicate that classified material had been plowed, leaving it open to inference that though the prescribed tests had been applied and found successful, the material had still been classified. This does not always show in the testimony, as the stenographer was repeatedly asked not to include certain portions of explanations and descriptions that were given by these and other witnesses.

Contract No. 27, page 76.—From the last sentence of the criticism on this contract, namely: "A drainage ditch in the prism of the canal was made with a plow," it might be inferred that the plowing was done through the hardpan, which was classified. That, however, was not the case, and the Commission knew it.

A ditch was made to carry the drainage to the Port Byron aqueduct, and it was made by plowing, but the bottom of the ditch was the bottom of the soft material overlying the hardpan, and this was not classified. The bottom of the ditch or the top of the hardpan was six inches above canal bottom, and as this depth was too light to justify blasting, it was picked. The material could not be plowed, as was demonstrated by the attempt made to plow out the ditch down to the level of the canal bottom.

Contract No. 2, Geddes Basin spoil bank.—Pages 96, 131 and 132. The statements on the pages mentioned relate to the improper payment of certain material as embankment, and to what the Commission seem to regard as an improper expense for the filling of what is known as Geddes basin. The engineers of the Middle Division testified that a certain amount of material that was within less than 1,000 feet of this Geddes basin spoil bank had been paid for both as excavation and embankment, because it had been hauled by locomotive and cars more than 1,000 feet in order to place it on the spoil bank. This part of the criticism was well grounded, because the State does not guarantee that the shortest practicable route shall be determined by any particular method of transportation. The engineers of the Middle Division apparently acted in good faith in this matter, but they have since been overruled by the State Engineer, so that the estimates at present do not include any material as embankment that was within 1,000 feet of this spoil bank, regardless of the method used for transporting it.

Concerning the desirability of filling the Geddes basin so as to provide a site for a State shop, the whole case has not been stated in the report. The site for a State shop was in reality a secondary consideration, though such a site and shop were badly needed. The facts are that for fully one mile east of the Geddes basin there were no available spoil banks, for a solid row of buildings lines one side of the canal, and the New York Central Railroad is on the opposite side. The situation exists to-day, just as it did when the work was done, and can be seen by anyone. There is no question about embankment or overhaul west of the Geddes

basin. The material east of the basin had to be put somewhere, and paid for as "embankment," and it seemed advisable to place this embankment so as to make some use of it. The State already owned the basin, and the only requirement to make it available was to build a wall to keep the material from washing back into the canal. The old basin was no longer serviceable for navigation, because it had been almost filled up with the wrecks of old canal boats and accumulations of sewage. The alternative of using the basin as a spoil bank was to acquire city property of sufficient area to hold the material that must be wasted. That would unquestionably have cost as much or more than the wall that was needed to make the basin serviceable, and would not have provided for the State the site it needed. It would instead have resulted in the disfigurement of the other lands that might have been appropriated, without effecting any saving to the State or accomplishing any desired object.

"Cinders used as lining."—On page 103 criticism was made of the use of cinders for lining on Middle Division contract No. 2. The Commission found out about the use of these cinders through an inspector who had been twice discharged for drunkenness and whose testimony was, therefore, that of a "sorehead." As a matter of fact, cinders constitute one of the very best of lining materials. The purpose they answer, as well as all other lining, is the same as that of ballast under a railroad track. Railroad men know that cinders make splendid ballast, except for the feature of dust when they are dry.

The people who recently built the sidewalks around the State Capitol grounds in Albany, and who had to guarantee the permanency of their work, also knew that cinders made good lining, and they were used under all the concrete that was laid. They have been used with splendid results back of masonry in many places on the canal, and because of their lightness, as compared with other lining materials, they have certainly saved the rebuilding of several structures that would have been forced into the canal by the weight of almost any other material that could have been used. The Newport bridge on the Jordan level and the Ohio

street swing bridge at Buffalo are examples of this kind, where, by taking out the earthy materials and substituting cinders, both structures have been saved from demolition. The reports do not dispute these facts, but seem to consider the use of cinders improper simply because in some cases they could be obtained by the contractor cheaper than gravel.

On page 97 criticism is made of the payment of both excavation and embankment prices for cinders used as lining, though the distance they say was not 1,000 feet between the points of excavation and deposit. The distance is practically 1,000 feet, and the only alternative method of payment was at the rate for lining, namely, \$1 per yard. Excavation on this contract cost 30 cents and embankment 27½ cents, and, under the circumstances governing the work at the time, the contractor agreed to accept the excavation and embankment price instead of the price for lining, because no other suitable materials were available unless hauled several miles, and the State thereby saved 42½ cents for each cubic yard. The material was used to great advantage through the marl and quicksand portions of the Jordan level.

“Piles at foot of walls.”—On page 105 the report says: “On contract No. 4, 3,000 railroad ties accepted as ‘piles at foot of wall delivered,’ costing the State \$2,160, were delivered and have not been used. Railroad ties and fence posts have also been accepted under this specification on other contracts.”

No fence posts have been accepted anywhere, and the ties that have been accepted conform in all respects to the specifications, and there was, therefore, no reason why they should not have been accepted. The statement as to the amount accepted and not used is erroneous. The Commission should have divided the amount by ten, for the proper amount is \$213.60, instead of \$2,160. It is an unfortunate error—for this Department.

“Triple-lap sheet piling.” This subject is criticised on pages 105 and 106. It has cost the State considerable money, not originally estimated for, but its use is known to have saved at least two serious breaks during the past season, and that it has been beneficial to the canal and to the State can not be successfully dis-

puted. The only sheet piling shown on any of the plans where this work has been done, was for the short lengths of say three or four feet that are sometimes used in the trenches in front of the vertical walls. The contractors held that the plans did not cover the use of long, triple-lap sheet piling that could only be driven by machinery, and it was found impossible to get any of the work done at the price named in the contracts simply for timber and plank. The alternative was either to agree on an equitable price for the additional work that was certainly involved, or to go to the trouble and expense of preparing plans for and advertising and letting numerous additional contracts. We chose the former course and still maintain that it was both proper and expedient.

“Measurement of triple-lap sheet piling.” On page 107 appears a criticism of a method once used under a misunderstanding of instructions for the measurement of sheet piling. It was found impossible to procure planks of ten inches in width for all of the work, and a considerable quantity of narrower planks were used. If each pile were to be paid for at a fixed rate, regardless of the width of the pile, or in other words, the length it would cover in the completed work, the narrow piles would, of course, be more expensive than the wider ones. It seemed essential, therefore, to fix upon some rate of measurement that should be uniform throughout the work, and ten inches was, therefore, adopted as the standard width, and all piles of less than that width were to be paid for by adding together the actual width of all the piles in the work and dividing the amount into ten-inch widths. If each pile were measured as it went in the work there would be no difficulty in doing this, but it would not answer to measure the combined lengths of the sheet piling after it was driven and dividing that length by ten, because there are necessarily a considerable number of spaces that can not be closed tightly as the piles are driven. Of course these spaces should not be paid for. The error was discovered some time ago, and the objectionable features have been entirely eliminated from the estimates.

“Criticisms of corrected errors.” The last clause on page 108 would indicate some pretty loose methods in this Department—if

the statement were true, but it is not. As a matter of fact, the error was discovered and corrected in the monthly estimate for January, 1898. In other words, it had been discovered and wholly eliminated from the estimates before the very existence of this Investigating Commission had even been suggested. But aside from these facts the Commission has not stated the case as it existed. The error of their statement, as in the case of nearly every error that was made, is on the wrong side of the balance sheet, and reflects on this Department. The facts are that the timber was not included in the estimates that were revised, at the contract rates and a force account allowance made for putting it in the work. It was included at the *actual cost price* and then an allowance by force account was made for putting it *in the work*. The Comptroller objected to this method of payment because there was a price named in the contract for this timber in the work. As a matter of fact this was more expensive than the method that was objected to but it was according to contract. Since the Commission knew all these facts, it is difficult to understand the intent of the criticism. Another instance of this kind is found in their statement at the top of page 134, that some of the contractors claimed that they should not be charged with old stone used in the work, and that the deduction therefor had not been made in some of the monthly estimates, though they say:

“The State officials have asserted their intention of including this material in the final estimates, and at that time deducting it from the payments to the contractors. Reference to some of the final estimates has shown that this has been done; but we are satisfied that the omission from the monthly estimates was unjustifiable.”

Well, perhaps it was, but what difference does it make to the State, so long as the deductions are eventually made?

It is common practice on all public work to sometimes withhold deductions like the above for a month or two, and sometimes the monthly estimates are made for quantities really greater than have actually been done, in cases where, for well-known reasons, the contractor may be temporarily embarrassed, and where that

embarrassment would prove a serious hindrance to the progress of the work. Monthly estimates are usually given on the fifteenth of each month for all work done up to the first of the month, and the work done by the contractor during those fifteen days is sufficient to guarantee the State against an overpayment. Moreover ten per cent. of the total value of all work done is always withheld until final payment, and becomes a further guarantee in these cases, in addition to the certified check of five per cent. of the amount of the contract, which is held till completion as another guarantee. We do not attempt to keep the contractor in funds, but there are cases where the above-mentioned allowances are both wise and expedient, and in no case has the State suffered thereby.

“Materials delivered and not used.” On pages 109 and 110, the Commission criticises relative payments for materials delivered and not used, and say that no such provision is contained in the contract or specifications. The specifications under “Timber and Lumber,” say: “Materials delivered as per bills and not used will be paid for at the market rates.” Payments of this kind have always been made on all State and other public works, and we believe that it has been repeatedly determined in the courts that materials ordered by the engineers and furnished, according to their bills, must be paid for. It is quite impossible that this work could have been stopped under all the existing circumstances without large quantities of unused materials being left on the work. The Commission says that so far as this improvement is concerned, these materials are lost, but just why that is the case is not clear. We maintain that they have not been paid for at more than market rates, and that every dollar's worth can be used to advantage either in completing this work at some future time or in the work of ordinary repairs.

“Embankment, Middle Division Contract No. 3.” On pages 96 and 97 our attention has been called to some embankment on this contract that has been improperly included in the estimates. After investigation, instructions have been given to eliminate the improper portion, though under the circumstances under which

the work was done, this will prove quite a hardship to the contractor.

“Borrowed material for raising banks.” Pages 51 and 52 cite certain contracts where material had to be borrowed for raising the banks. Aside from the statement that no attempt was made to use the materials from the necessary excavation for this purpose, the several statements would not require further comment, but their statement is not true. All of the necessary excavation has been used either for raising or strengthening the embankment. Such of it as was fit for the tops of the bank has been so used, and it was only because there was not enough of this kind of material for the purpose, that other material had to be borrowed to make up the deficiency. The whole matter was carefully studied before any of the work was done, and it could not have been done otherwise. Under Contract No. 26 they say that “44,000 cubic yards of shale and cemented gravel which would have been suitable for use in embankment” was excavated, and though they do not state it, the inference is that this material was wasted because the borrowed materials had filled the use to which these 44,000 yards might have been placed. As a matter of fact the quantity stated was actually used as they think it should have been.

“Percentage of increase of excavation on Middle Division.” On page 50 mention is made of the increase of excavation that will be required to complete the work. The whole statement is grossly erroneous, and incidentally it shows a considerably higher percentage of increase than is indicated by our office data. The following table will indicate the care with which their work was done:

	Quantities as per Commission's report.	Quantities as per our office data.	Difference.
Preliminary estimate.....	Cubic yards. 1,532,370	Cubic yards. 2,317,050	Cubic yards. 784,680
Done and to be done.....	2,171,724	3,169,012	997,228
Percentage of increase	41.72	36.76	4.96

“Excess of excavation, Middle Division Contract No. 5.” On page 55 an attempt is made to discredit measurements of our engineers as well as their sworn testimony. This contract is 4.61 miles long and the horrible fact has been discovered by the Commission that the amount of excavation disclosed by the first cross-sections must be increased, according to those taken when the work was started. The insinuating manner in which their criticism is made might be justified if no testimony on the point had been adduced. On page 2886 of the testimony it will be seen that Assistant Engineer Holmes stated that one year elapsed between the taking of the two sets of cross-sections, and that the first ones were taken when snow and ice were in the canal, and that the second ones were taken more accurately. In addition to his testimony, the further facts are that it was impossible to punch the leveling rod down through this snow and ice and determine the elevation of the top of the silt with any great accuracy. When the second cross-sections were taken the engineers were provided with appliances to prevent the rod from sinking into the silt, and as the snow and ice were then out of the canal a greater number of elevations could be taken at each cross-section and greater accuracy was thereby secured. In addition to the difference disclosed by these two sets of cross-sections, it was also actually found that in the prism of the canal west of Jordan, where the canal bottom was excavated down to grade in hardpan during the summer of 1897, that a large quantity of silt had washed into the canal and covered the hardpan that had been excavated. The material came from a “wide-water” near this point, and a recurrence of the trouble will be prevented by a riprap or loose stone filling that has since been built.

WESTERN DIVISION.

Contract No. 12, page 76.—This criticism refers to “reclassification,” as the Commission chooses to call it, but they omit to state that little or no work was done during the spring months on this excavation and water covered the excavated portion, and as the resident engineer could not judge intelligently of the char-

acter of the material when it was frozen, he deferred his decision until the frost was out of the ground, when a careful examination was made and his decision rendered accordingly. The reason for deferring the classification was a most excellent one and applied to other contracts as well as this one, and serves as a further indication of why it was impossible always to decide about these figures at the time the work was done, as the Commission seem to think should be done.

Contract No. 10, page 77.—The report implies that the height of the classified material was determined solely by the elevation, as shown on the berme bank, after the material was excavated, and that this height was carried across the entire width of canal, except where it intersected the surface line of the cross-section of total excavation. This is not the case. The hardpan in question dipped at a considerable angle, and in no case was it as high on the towpath as on the berme side. In most cases the cross-section of hardpan runs to zero at about the center of the canal, and this point is well defined, and has been measured, except for a short distance where Assistant Engineer Bannister was unable to get the record, as the work progressed, because of the pressure of other duties. It does not follow, however, that the records and measurements obtained later are in error. The line of demarkation between the hard and soft material is so well defined that there is little possibility of error.

Contract No. 9, page 77.—Very much less than half of this classified material was estimated, as the Commission say, by taking elevations on banks and sides of cuts after excavation. All materials so measured were also measured by further rod readings or elevations taken on the hardpan in the center of the canal which was undisturbed, owing to a car track being placed on top of the original prism and left there until the close of the work. This allowed the taking of four rod readings at each cross-section, and this was amply accurate for any purpose.

Contract No. 5, pages 78 to 80, inclusive, and pages 114 and 115.—The main facts, as stated on pages 78 to 80, inclusive, regarding this contract are correct, and unquestionably the exist-

ence of rock or materials that would have to be classified as rock should have been known to those who were making the computations in the division engineer's office, on which the bidding sheet was based. The data showing the existence of rock did not reach the division engineer's office with the other data, and when it was finally sent in it seems to have been mislaid and overlooked. In fact it was not discovered until nearly two years after the surveys were made. There seemed to be no reason to question the reliability of the original estimate when it was submitted to the State Engineer, neither was there any reason to question the bid of the contractor, for it might reasonably cost \$3 per yard to provide the appliances for and excavate only 100 yards of rock. All the other prices were as low or lower than prevailing prices for similar work.

On pages 114 and 115, referring to this same Contract No. 5, the report criticises an improper payment for some gravel used for repairing slope walls, because the payments netted the contractor more than his contract prices. The criticism in itself was well founded, but the resident engineer's testimony followed that of the assistant engineer, and the former acknowledged the error, and said that he would have the improper items of expense eliminated from the estimate. This has since been done.

"Mucking." Contracts Nos. 13, 14 and 15.—One page 54 the report says: "The work which they did was to a great extent unnecessary and consisted of mucking sites for spoil banks. The testimony is that on one contract about 5,000 cubic yards of mucking was done, of which at least half was entirely unnecessary." The facts are that *no* spoil bank sites were mucked, the only work of this kind being on the outside of weak banks that were to be strengthened. The assistant engineer in one case used poor judgment in allowing the contractors to do the mucking over a territory twice as large as would be needed during the winter of 1897 and 1898. We can not guarantee that none of our several hundred assistants will not make errors of this kind when working on their own responsibility.

"Excavation behind vertical wall." Contract No. 1 (see page

55).—Because the cross-sections showed excavation extending from four to eight feet horizontally back of some vertical wall on this contract, the Commission seems to think that it has discovered another “abuse.” The resident engineer testified as fact—not suggestion—that the conditions rendered this excavation necessary. The land in the vicinity is “made” ground and is on top of the old Lake Erie beach. When the excavation for the wall was started, the water from Lake Erie percolated through the sand, carried the sand with it and undermined the top or made strata. A “cave-in” necessarily followed, and it was this material that had to be excavated back of the walls. The Commission does not state how this could have been prevented. The amount of water percolating through the sand was so great as to require the use of pumps every ten or twelve feet. The work was very difficult and the men were in great danger.

On the same page a criticism is found for the payment of dry excavation prices for some material that was excavated with a dredge. Possibly some testimony was taken on this point but we have no knowledge of it, and incline to the belief that the Commissioners formed their judgment from the cross-sections alone, without ascertaining the cause that led to the necessity for the work being done by dredge. The place in question consisted of a vertical wall which was underpinned, it appearing to be good enough to be saved in that way. After *that portion* of the canal was opened to navigation and the coffer dams removed, the wall fell in and there was no other alternative but to dredge out the caved material, sink cribs and build a new wall on top. To have done this work dry would have cost at least \$15,000 for coffer dams. The excavation being on the area that was let “dry,” the price was allowed for “dry excavation.” This was consistent with our ruling on Contract No. 2, which was let “wet,” and while the contractor did some of the excavating “dry” at his option, he was paid for “wet excavation,” making a saving to the State of fifteen cents per cubic yard. This was plainly in accordance with the specification, which says:

“But it is distinctly understood that the words ‘dry’ and

'wet' used above and in the following items under the general head of excavation, are used only to distinguish excavation from sections of the canal that can be drained naturally or artificially, as provided under 'Bailing and Draining' from those sections where the canal can not be drained, or where its drainage is not contemplated."

ALLOWANCES TO CONTRACTORS.

On pages 134, 135 and 136 criticism is made of an allowance to the contractor of old stone on Eastern Division Contract No. 7, and of stone taken from the necessary excavation on Western Division Contract No. 1, and given to the contractor. The first case is partially described in the Commissioner's report. The flooding occurred because of the improper manipulation of State waters at Ilion, and the damage to the contractor was certainly great. Every time the work was flooded, and it occurred quite a number of times, the water would freeze in the canal, and this ice would have to be removed before the excavation and the work on the walls could proceed. The foundations of the walls had to be taken up and relaid a number of times, and as the contractor had a right to expect, as we thought, that he might be protected against this damage by proper care on the part of the State, it seemed that he had a proper claim against the State, which could not have been successfully disputed had the matter been brought before the Board of Claims. At the same time that this claim was made, other claims amounting to several thousand dollars were made by the same contractor, and each of these had some merit. It was afterward agreed to disallow all the claims except the one in question and thereby settle the whole dispute and avoid litigation.

Concerning the stone on Contract No. 1 at Buffalo the situation was quite different. The material came from within the limits of the section on which it had been agreed to pay embankment as well as excavation prices. The only way by which we could avoid hauling the material more than 1,000 feet, and paying for it as embankment was to acquire several pieces of valu-

able city property. The contractor thought he could separate the earth from the rock that was being excavated and handle the latter to his advantage, and, therefore, agreed to assume all of the expense of acquiring the spoil banks for this material if he could afterward use it as he saw fit. It was a question of choosing the lesser of two evils and his proposition looked like and was a good opportunity to save the State some money and was, therefore, accepted. He has simply *leased* several lots on which this material has been placed, and he now asserts that these leases have cost \$15,000, and that the transaction will involve him in a considerable loss, notwithstanding he has the best of facilities for handling, crushing, using and selling these materials. The State could not have put the material to any useful purpose whatever as it is not in the mercantile business.

If we had not paid the embankment as well as the excavation price, then the contractor would not agree to take the materials, and we would then have been obliged to pay for the necessary spoil banks. Not all of the material placed on these spoil banks was paid for as embankment as might be inferred from the report. Resident Engineer Neher testified that only about half of it had been so paid for.

After the matter of cost of land for spoil banks in the city of Buffalo has been adjudicated by the Board of Claims, we think it will be apparent why the course adopted was a wise one and that it has saved the State a considerable sum of money.

The State Engineer never received an offer for this surplus stone, as stated in the report, but he did receive an inquiry as to its value from Carroll Brothers of Buffalo.

It is decidedly easier to criticise than it is to direct what shall be done.

The foregoing statement is believed to cover every criticism of any importance made by the Commission or its engineers, in so far as they relate to this Department.

It is believed to demonstrate our claim that a cruel injustice has been done to the canal officials, and that incidentally a

crushing blow has been dealt to the entire canal interests of the State.

It would be idle to claim that this work has no flaws, either in execution or supervision. It unquestionably has imperfections in both; any work of equal magnitude, especially when done under the conditions that have governed, is bound to have—but it certainly merited a far different report than has been made.

Respectfully,

C. W. ADAMS,

State Engineer and Surveyor.

APPENDIX No. 2.

APPENDIX No. 2.

To Report upon Topographic Survey of the State.

DESCRIPTIONS OF PRIMARY TRIANGULATION STATIONS.

The following includes descriptions of all primary triangulation stations occupied in the State of New York during the field season of 1898. As this work was not completed during the field season, the numbers of the stations were not stamped on the copper bolts in some instances. The geodetic coordinates of these stations are not published herewith, as in the past, for the reason that they are published by the United States Geological Survey, and it seems unnecessary to duplicate such publication here. This information will indicate to all interested the general location of triangulation stations. Further information as to their positions can be had by communicating with the director of the United States Geological Survey, Washington, D. C., or through the office of the State Engineer at Albany.

MURRAY, SENECA COUNTY.

Situated in the town of Lodi, on the highest ridge of land between Seneca and Cayuga lakes, about 300 yards north of the road from Trumansburg to North Hector. Eight miles from Trumansburg. Land of William Murray:

Station mark; stone post 6 inches by 6 inches by 4 feet sunk in ground to within 6 inches of top; copper bolt in top. Station number 501.

SWEET'S HILL, SENECA COUNTY.

Situated in the town of Fayette at the highest point of hill locally known as Democrat Hill. Two miles east of West Fayette and six miles south of Waterloo:

Station mark; stone post of the Survey, State of New York, marked "99."

GENOA, CAYUGA COUNTY.

Situated in town of Genoa, on the highest of three small hills on top of ridge to the west of village of Genoa, being one-eighth mile west of the Indian Ridge road, and one and one-eighth miles north of intersection of east and west road, passing through Genoa and Indian Ridge road. Land of James McDermott:

Station mark; cut and dressed stone 3 inches by 3 inches by 12
U. S.
inches with on top; sunk one foot under ground.
G. S.

WEST MOUNTAIN, HAMILTON COUNTY.

A dome-topped mountain in the town of Long Lake, on the west side of Raquette Lake. Summit of mountain has been entirely cleared:

Station mark; copper bolt in rock on highest point. Station number 494.

Mountain also has bolt of Colvin Survey. Spruce log signal built in 1898.

West mountain is best reached from Antler Hotel, Raquette Lake, by small beat to trail near the house of Mr. Blanchard on north side of Sucker brook bay. Thence four miles to top of mountain. Water within one-half mile of top of mountain.

ITALY HILL, YATES COUNTY.

Situated in the town of Italy on the highest point of hill, three miles west of the village of Italy Hill, and south of the road leading from Italy Hill to Italy Hollow:

Station mark; stone post 6 inches by 6 inches by 4 feet sunk to within 6 inches of top; copper bolt in top marked "U. S. G. S., 499 N. Y."

GENEVA, SENECA COUNTY.

Situated in the town of Geneva, just west of the city limits of Geneva, on a line running west from Preemption road, and separating the farms of Henry Davis and John Ross:

Station mark; stone post 6 inches by 6 inches by 4 feet sunk in ground to within 6 inches of the top; copper bolt in top of post marked "U. S. G. S., 498, N. Y."

SMITH'S LODGE, HAMILTON COUNTY.

(Secondary Station.)

Situated in Long Lake town on the west side of Lake Lila, just above the station of Nehasane, on a ledge of rock looking to the north and southeast:

Station mark; half inch copper bolt in rock. Station number 496.

ORLEANS, ONTARIO COUNTY.

Situated in town of Phelps on highest part of north and south ridge, about two miles from Clifton Springs, and one mile from Orleans; one-eighth mile east of road from Orleans to Clifton Springs:

Station mark; stone post 6 inches by 6 inches by 4 feet sunk in ground to within 6 inches of top; copper bolt in top. Station number 491. Sawed lumber signal in 1898.

BARE HILL, ONTARIO COUNTY.

Situated in the town of Middlesex on the north crest of a bare hill, on the east side of Canandaigua Lake:

Station mark; stone post 6 inches by 6 inches by 4 feet sunk in ground to within 6 inches of top; copper bolt in top of post. Station number 492. Sawed lumber signal in 1898.

MT. MORRIS, FRANKLIN COUNTY.

A high, bald mountain in town of Waverly, four miles east of Big Tupper Lake and six miles south of Tupper Lake post-office.

Station mark: Copper bolt marked "U. S. G. S. 497 N. Y." Spruce pole signal, 1896.

Mt. Morris is best reached from Tupper Lake post-office by driving to Waukesha hotel, thence by logging road which leaves main road at south corner of field in rear of hotel. Follow this

two miles to logging camp and one-eighth mile beyond to road forks. Take left-hand road. Thence one-fourth mile to a deserted logging camp, thence by trail and skid roads direct for summit.

KEMPSHALL, HAMILTON COUNTY.

A heavily timbered mountain in the town of Long Lake, on the east side of Long Lake, ten miles south of Island hotel. Lines are cleared through timber to Blue Mountain, West Mountain, Niggar Head, Owles Head, Mt. Morris, Mt. St. Regis and Mt. Ampersand.

Station mark: Trunk of tree two feet in diameter cut off twenty feet from ground, which was used as rest for instrument. Scaffolding built around tree. Two feet northwest of tree center there is a witness mark, consisting of a copper bolt in a boulder two and one-half feet in diameter, which is imbedded in the roots of the tree. Station No. 493.

Kempshall is reached from Highland hotel in Long Lake by boat to point in the lake occupied in 1898 by Moody's logging camp. From this point go by trail to spring and up blazed trail and an intricate series of trails and logging roads toward the summit.

NIGGAR HEAD, HAMILTON COUNTY.

(Secondary Station. Unoccupied.)

A round topped mountain in town of Long Lake about four miles west and north of Forked Lake.

Station mark: Copper bolt in rock. Station No. 495.

CHESHIRE, ONTARIO COUNTY.

(Secondary Station.)

Situated on bare hill one and one-half miles north of village of Cheshire, town of Canandaigua. On highest point of hill. Land owned by Warren Outhouse.

Station mark: Stone post 6 inches by 6 inches by 4 feet, sunk in ground to within 6 inches of top. Copper bolt in top. Station No. 490. Sawed lumber signal over post in 1898.

PRECISE LEVELING

OF THE

United States Geological Survey.

Precise Leveling of the United States Geological Survey.

The Geological Survey precise level is made by Messrs. Buff and Berger of Boston, and differs from the above in essential details. Two views of this instrument are shown. The plan of this instrument was suggested to Messrs. Buff and Berger by Mr. Van Orden for use on the Massachusetts Topographic Survey, and is, in general, as follows: The tripod and head are similar to those of the instruments already described. On the head the level is supported freely by three leveling screws, and it is clamped to the tripod head by a stout center screw when not in use. The telescope has an aperture of $1\frac{1}{2}$ inches and a magnifying power of 40 diameters, and is inverting, as are the others. It likewise rotates in vertical plane by means of a milled head screw nearly under the eye-piece; but this rotation is about a horizontal axis, not under the object glass, as in the other instruments, but placed opposite the center of the instrument by means of a cradle, the axes of which are within a fraction of an inch of the line of collimation, thus securing in the telescope a motion in altitude free from any change in the height of the line of collimation, as must occur in the other instruments. It is leveled by a long spirit bubble hanging from the telescope, as in ordinary spirit levels, and in addition is supplied by the makers with an auxiliary striding level. The bubble is so graduated that one division 1-10 inches in length is equivalent to 4 seconds of arc. The Geological Survey do not use the striding level, nor do they use the micrometer leveling screw as such, but merely as a milled head screw for final leveling. In place of the chambered bubble, as furnished by the makers, two bubbles of different sensitiveness are carried in the field, one, in which a division is equivalent to 4 seconds of arc, and the other in which a division is equivalent to 8 seconds of arc, and both are carried

in separate metal frames so that they can be changed without much delay. Some improvements are being attempted in a level of this kind now under construction for President Mendenhall of the Worcester Polytechnic Institute; these consist of a steel center pivot, hardened steel collars, agate bearings in the Y's, etc.

The rods used by the Geological Survey (see Fig.) are about 10 feet in length, non-extensible, T-shaped in cross-section and made of two pieces of pine frequently bolted together. They were made of well-seasoned paraffined pine, by Messrs. W. & L. E. Gurley, of Troy. The bottoms are truncated pyramids of hardened steel, one-half inch in width at the smallest or lowest end, and these are placed on the top of the convex-surfaced turning points. No difficulty is experienced in placing the rod exactly on the highest part of the turning point and there is less liability of error by possible carelessness in properly wiping both surfaces. The rod is graduated much as is a New York rod, to feet and hundredths, and is read by a target to thousandths of a foot. The design was suggested to Mr. Van Orden by Assistant Braid of the Coast and Geodetic Survey, and it was made from their plans, which have been considerably modified in the rods used by the Geological Survey.

These rods, as made for the Geological Survey, are not thoroughly paraffined, as has been the practice in the Coast Survey, but are paraffined only to a moderate depth, about one-eighth inch, it being found that light pine wood soaked in boiling paraffine until it has penetrated to this depth gives the rods the proper resistance to atmospheric changes, rendering them especially capable of resisting moisture, and yet not changing the texture of the wood as when thoroughly soaked with paraffine, which makes it soft and cheese-like and causes it to easily dent and bend. In a thoroughly paraffined rod, the paraffine boils out of the rod in hot weather, making it sticky, while the rod itself loses many of the valuable properties given by the wood. Shallow paraffining retains the desirable properties possessed by the wood and affords sufficient holding wood for the screws, enabling the rod to retain its rigidity and rendering it less easily affected by changes of temperature.

[illegible]



FIG. 4 BUFF AND BERGER PRECISE LEVEL.



FIG. 5.

These rods were sent to the United States Coast and Geodetic Survey for testing, and Table No. 3 shows the lengths of rods *A* and *B* at a fixed temperature.

TABLE No. 3.

ROD "A," TEMPERATURE 21.24° CENT.

0 to 1 foot.....	12.010 inches
0 to 2 feet.....	24.012 inches
0 to 3 feet.....	36.013 inches
0 to 4 feet.....	48.017 inches
0 to 5 feet.....	60.016 inches
0 to 6 feet.....	72.016 inches
0 to 7 feet.....	84.016 inches
0 to 8 feet.....	96.015 inches
0 to 9 feet.....	108.015 inches
0 to 10 feet.....	120.015 inches

ROD "B," TEMPERATURE 22.12° CENT.

0 to 1 foot.....	12.023 inches
0 to 2 feet.....	24.017 inches
0 to 3 feet.....	36.019 inches
0 to 4 feet.....	48.021 inches
0 to 5 feet.....	60.021 inches
0 to 6 feet.....	72.021 inches
0 to 7 feet.....	84.023 inches
0 to 8 feet.....	96.022 inches
0 to 9 feet.....	108.023 inches
0 to 10 feet.....	120.024 inches

At the end of the field season these rods were returned to the Coast Survey office for a more exhaustive test, which consisted of a determination of their lengths after being in a dry room for a month, and of their lengths after being exposed to a relative humidity of 92 per cent. for forty-five hours.

The results, referred to 22.2° Cent., are as follows:

	Rod A.	Inches.	Rod B.	Inches.
First comparison....	1 to 10 feet,	108.011	1 to 10 feet,	108.003
Second comparison..	1 to 10 feet,	108.011	1 to 10 feet,	108.006
Difference.....		0.000		0.003

These results appear to indicate a slight increase in the length of rod *B*, but, as the lines are not very finely marked, and as the distance, 1 to 10 feet, is the result of the summation of the spaces, 1 to 4, 4 to 7 and 7 to 10 feet, it is believed by the assistant in charge of the Coast Survey testing-room that little or no change took place. The Superintendent of the Coast Survey stated in his letter of transmittal that weight is lent to this conclusion by the fact that rod *A* showed no change, although both rods were treated exactly alike.

The targets of the Geological Survey rods are rectangular, 4 inches high by $5\frac{1}{2}$ inches wide, with a slot in the center, in which the vernier is placed, as in the New York rod. One peculiarity of these targets is that instead of a line on which to center the cross-hair, there is a white stripe, tapering so as to be narrowest near the graduation and widest on the outside, being 0.004 foot wide near the vernier and 0.020 foot wide at the outer edge (see Fig). This stripe is more easily bisected and a more accurate setting can be made on it than on a line which is entirely superimposed and rendered invisible by the cross-hair, the image seen being four similar triangles, merging into nothing at the horizontal cross-hair. The metal supporting the vernier of the target is cut back for $1\frac{1}{2}$ inches, and is channeled on the rear side so as to make it spring. It can be pressed against the face of the rod so as to get a close contact with the graduation when being read, thus eliminating much of the parallax encountered in reading the ordinary target on New York or similar rods. The target is raised and lowered and is given a slow motion by an endless steel tape, similar to a measuring tape, which passes over pulleys at each end of the rod, one of which is adjustable so as to give the proper amount of tension, and this tape is moved by the hand of the rodman from behind and with such friction as will permit of giving the proper slow motion. There is no means of clamping the target when the rod is in position, as is done by the chain on the Coast Survey rod. The rod must be taken down to be clamped. This is an advantage, because it in-

FIG. 6. GRADUATIONS OF PRECISE SPEAKING ROD, FULL SIZE.

sure the target being clamped before it is replaced on the turning point for the final sight of the levelman.

Because of the mode of running these precise levels as explained further on, it was necessary that each rod should be graduated on both faces—that is, that each rod should be a double reading rod so that after sighting to one side and determining the difference of elevation, it would be possible to immediately turn the rod around and sight to the other side in similar manner. For purposes of better check on the readings read on both sides of the rod and that the duplicate lines hereafter described should be as distinct as possible one from the other, it was decided that while the front face of the rod should be graduated as above described and be read with the target and vernier, the rear face rod should be a speaking or self-reading rod, read from the instrument by the levelman instead of by the rodman. After much inquiry as to forms of speaking rods for such purposes most of the precise forms of which are derived from European types, the following type of rod (see Fig.) was selected largely as a result of information and advice from Mr. Horace Andrews, city engineer of Albany. The division of this rod is planned after one in which a meter is divided into fifths, the theory being that the eye aided by the cross-hair of the instrument could easily estimate fifths of a space, whereas it could not estimate tenths. In order to bring about a corresponding result, and as a foot is too small a division to divide in the manner desired, this rod is divided into units of 2 feet. Accordingly, every actual foot is but half of a unit, and so on for tenths and hundredths, the result being that a rod 10 feet long is divided into five units, each unit into five others, etc. Accordingly, it is easy to read one-fifth of the smallest unit space on the rod by estimation with the cross-hair, and the smallest space being .01 of a unit, a fifth of it is .002 of a unit, actually equivalent to .001 of a foot. The portion which is hatched with diagonal lines is painted red.

The mode of keeping the notes is unique. Whatever the initial elevation may be, say 100 feet, it is put in the column of elevations as being one-half of this, or 50 feet. Then the back and

fore sights are recorded, and the computations made as with any other rod, the actual figures read being used. Whenever a bench-mark is reached and it is desired to know its elevation, that given in the book is doubled. This introduces no complications in note keeping, simplifies the rod reading and permits of the estimation of differences of heights on a speaking rod to .001 of a foot.

Instead of saucer-shaped turning points in which grit is apt to collect, even if every care is taken in wiping them, the Geological



Fig. 7.

Survey uses convex-headed steel turning points (Fig. 7) 10 to 15 inches in length and $\frac{3}{4}$ inch in diameter. They are machine-dressed from 3-inch steel bars, and the top is enlarged to a mushroom shape $2\frac{1}{2}$ inches in diameter. The spike is thoroughly driven into the ground to a firm bearing. This form of turning point has been found by the Geological Survey to be more steady in frozen and soft ground, and under similar unfavorable conditions, than the shallow plate of the Coast Survey or the turtle-back of the British Ordnance Survey. In the experiments to neutralize the effect of frozen ground on tripod legs and turning points, as hereafter explained, cast-iron turtle-back turning points 6 inches in diameter, about $1\frac{1}{2}$ inches thick, flat on the under side, and with three 1-inch spikes, similar to those of the Ordnance Survey, were employed for a short portion of the North Carolina line, between miles 205 and 210.

Various methods of progression have been employed by different organizations in the running of precise levels. The method which seems most satisfactory and that adopted in this work was to use one instrument handled by one levelman and to keep the instrument shaded at all times from the sun and wind by an umbrella or when being carried by a hood. Two rodmen, each with a double graduated rod as already described were employed and they were not permitted to select lengths of sight exceeding 300 feet as a maximum which was but occasionally reached because of disturbances of the atmosphere. The levelman sighted backsights at rods held on two different turn-

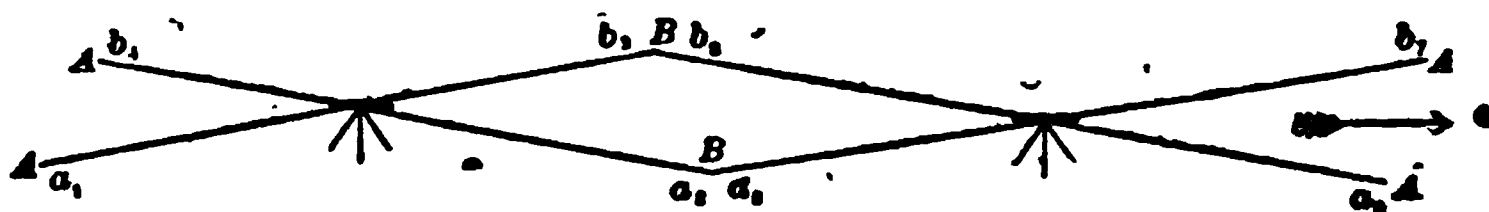
ing points, one on one side of the railway track and the other on the other side so that they should be clearly distinct one from the other and should not be confused one for the other. He likewise observed from the same side of his instrument two foresights on rods held on two separate turning points as in the case of the backsights. The result was what is called a simultaneous duplicate line of levels or simultaneously double rodded line.

An examination of such work as conducted by other organizations disclosed the fact that with most of them the method of observing was such as to leave the instrument standing too long between the time of observing back and fore sights. A notable peculiarity in all such precise leveling is that there is a constant divergence between the two lines to explain which no adequate cause seems assignable. This divergence was believed, however, to be due largely to settlement of the instrument between the time of observing back and fore sights on the same line. In order to eliminate such settlement the following method of observing was adopted. In its application the instrument was not moved nor disturbed between the time of sighting the direct and the reverse lines, this being merely an exaggeration of the actual movement which took place in the possible settlement of the instrument and the necessary releveling. The foresight of such constituted in itself a sufficient disturbance. The mode of observing was such as to make the line first sighted a direct line—that is, backsight was first observed and then foresight, in the direction in which the party was moving. The second line was observed as a reverse line—that is, a backsight was observed first on the forward point, that toward which the party was moving, and foresight was observed on the rear point, that in the direction the levelman had just gone.

This method of procedure was to backsight on rodman *A* at a^1 (see Fig.) immediately reversing the instrument foresight on rodman *B* at a_3 then foresight on rodman *B* at b_2 and backsight on rodman *A* at b_4 . In this method it will be observed that the level notes are complicated or divided between the two rodmen, because

one rodman acts as backsight on both rear turning points, and the other rodman as foresight on both fore turning points. The levelman, however, keeps a clear set of notes of both rod readings, and the rodmen exchange fore and back sight notes at the end of a day's work by summation between bench-marks. The advantage of this method is in the quick observing between fore and back sights on each line, practically no time elapsing between the making of these sights other than that required in reversing the instrument and watching the bubble. It was believed that by this method practically no subsidence occurred between these sights, a belief borne out by the fact that the greater length of time elapsing between the sighting of the two lines resulted in a greater divergence than might even have been anticipated. The order of sequence in sighting was such as to practically run one line in a direct and the other in the reverse or opposite direction.

The method of exchanging notes required each man to practically walk the distance leveled twice, for after rod a_1 is sighted, then the rodman moves toward the levelman for his inspection; meantime the latter sights rod a_2 , then the levelman moves toward



A to meet him, and they exchange notes, A returning to point b_4 and the levelman going to meet B , whose rod he reads, B then returning to point b . The second set of sights having been made, the notes are exchanged as the men pass each other, the rear rodman and levelman moving forward each time.

LIST OF ELEVATIONS FROM PRECISE LEVELING.

Dunkirk via Olney, Hornellsville, Elmira, Binghamton, Oneonta and Schenectady to Cohoes.—The elevations in the following list were determined in the course of the running of precise levels from the United States engineer's bench-mark in Dunkirk via the lines of the Erie Railway and Delaware and Hudson Railways to the precise bench-mark of the United States engineers in Cohoes.

connected with and dependent upon the United States Coast and Geodetic Survey precise levels brought from Sandy Hook to Albany. The elevations are based on a bench-mark of the United States engineers described as "Top of water table; extreme north-western corner of Nelson Block, Center street," the elevation of which was given as 587.805 feet above mean sea level at Sandy Hook, which height was obtained through a series of continuous records of the Dunkirk gauge for a period of one year as referred to the more permanently established gauge at Erie, Pennsylvania, the whole reduced to the new Coast Survey mean sea level by applying the correction—1.085 feet as explained in the Appendix to my last Annual. Based on this there was established in the parapet of the west pier in Dunkirk harbor, an aluminum tablet marked "581 D" the height of which is accepted as 580.81 feet above mean sea level.

Near Schenectady connection was made with a published bench-mark of the United States engineers on Rexford Feeder bridge, near Upper Mohawk aqueduct. The closure error was so great, however, that it appeared that this structure must have settled or been moved. Accordingly at the end of the season the levels were run eastwardly to Cohoes checking on the various benchmarks of the United States engineers which were found to differ considerably among themselves and from the precise levels, due probably to settlement or change in the structures since placing of these benchmarks. Towards Cohoes three separate benchmarks were found which appeared to have remained unchanged and which agreed among themselves and with the precise levels to within a few thousandths of a foot, and the connection with these benchmarks gave a closure error of the total line of .645 feet, the most acceptable of these benchmarks being that on Lock No. 15 at Cohoes.

The leveling was done by Mr. E. L. McNair, assisted by Messrs. J. E. Buford and W. F. Hammond, rodmen, and was executed under the general direction of Mr. H. M. Wilson, geographer. All benchmarks placed in the progress of this work between Cohoes and Elmira were marked with the letter "A" or the word "Albany" in addition to the figures of elevation, thus referring them

to the Coast Survey benchmark at Albany as a datum. All benchmarks placed between Dunkirk and Elmira were marked with the initial letter "D," thus referring them to the United States engineer's benchmark at Dunkirk as a datum.

	Elevation.
Dunkirk, parapet of concrete superstructure of west pier in harbor; 28 ft. from west end of; aluminum tablet marked "581 D".....	580.881
Dunkirk, Nelson block, extreme northwest corner of; top of water table.....	587.805
(Note.—This temporary B. M. is 16.03 feet above mean level of Lake Erie.)	
Dunkirk, 1 1-3 miles east of Nelson block; top of rail at crossing of Erie and N. Y. C. and St. L. Ry. (Nickel Plate)	617.80
Dunkirk, 2.1 miles east of Nelson block; top of rail under private overhead crossing.....	648.09
Sheridan, 1 $\frac{3}{4}$ miles west of; top of rail at center of iron bridge over highway.....	684.93
Sheridan, 1.1 miles west of; top of rail at center of iron bridge over highway.....	710.42
Sheridan, $\frac{1}{2}$ mile west of; top of rail at center of iron bridge over highway	732.64
Sheridan, 0.4 miles west of; top of rail at center of iron bridge over private road.....	740.57
Sheridan, 850 ft. west of; top of rail in center of iron bridge over private road.....	749.42
Sheridan, top of rail opposite Erie station.....	757.13
Sheridan, 1,850 feet east of; top of rail at highway crossing	771.20
Sheridan, 1 $\frac{1}{2}$ miles east of; top of rail under overhead highway crossing	815.89
Forestville, 530 feet west of entrance in waiting room of Erie station. In bridge seat at northeast corner of iron bridge over highway; 7 feet north of center of track. Bronze tablet marked "871 D".....	870.784
Forestville, top of rail opposite Erie station.....	874.33

	Elevation.
Forestville, .7 mile east of; top of rail at center of iron bridge over highway.....	887.45
Forestville, 1 mile east of; top of rail at center of iron bridge over ravine.....	902.90
Forestville, 1.9 miles east of; top of rail at road crossing.....	933.73
Smith's Mills, .9 mile west of; top of rail at road crossing.....	975.84
Smith's Mills, top of rail opposite center of Erie station.....	1,009.60
Smith's Mills, 2.3 miles east of; 10½ feet north of center of railway track in foundation stone under west end of overhead highway bridge. Bronze tablet marked "1,097 D," 1898.....	1,097.494
Smith's Mills, 3.15 miles east of; top of rail at road crossing.....	1,126.30
Perrysburg, 3 miles west of; top of rail at road crossing.....	1,153.00
Perrysburg, 2 miles west of; top of rail at road crossing.....	1,194.74
Perrysburg, 1.2 miles west of; top of rail at road crossing.....	1,215.36
Perrysburg, top of rail opposite center of Erie station at.....	1,263.93
Perrysburg, Erie station at; 400 feet east of waiting room. In keystone at north end of stone arch culvert under railway. Bronze tablet marked "1,261 D," 1898.....	1,261.264
Perrysburg, 1.9 miles east of; top of rail at road crossing.....	1,323.40
Dayton, .35 mile west of; top of rail at road crossing,	1,325.6
Dayton, Erie Ry. station at; 950 feet north of; 37½ feet east of center track; coping of tunnel underneath Erie track; second step stone from top. Bronze tablet marked "1,322 D".....	1,321.762
Dayton, top of rail at Erie station at.....	1,336.0

	Elevation.
Dayton, .9 mile east of; top of rail at road crossing..	1,358.0
Dayton, 1½ miles east of; top of rail at road crossing	1,380.5
Dayton, 3 miles east of; top of rail at road crossing..	1,337.9
Dayton, 4 miles east of; top of rail at road crossing..	1,322.8
Cattaraugus, Union school building at; in water table at right of main entrance to. Bronze tablet marked "1,401 D"	1,384.424
Cattaraugus, top of rail at Erie station.....	1,414.0
Cattaraugus, ¾ mile east of; top of rail at road crossing	1,445.5
Cattaraugus, 1½ miles east of; top of rail at road crossing	1,476.5
Little Valley, 4.4 miles west of; top of rail at road crossing	1,531.5
Little Valley, 2¾ miles west of; top of rail at road crossing	1,600.8
Little Valley, 1.6 miles west of; top of rail at road crossing	1,590.3
Little Valley, ½ mile west of; top of rail at road crossing	1,582.1
Little Valley, Cattaraugus county courthouse at; foundation wall at southwest corner of. Aluminum tablet marked "1,593 D".....	1,593.011
Little Valley, Erie Railway station at; top of rail.....	1,565.2
Little Valley, ¾ mile east of; top of rail at road crossing	1,541.0
Elkdale station, top of rail at.....	1,563.1
Elkdale station, ¾ mile east of; top of rail at Bridge No. 36	1,440.40
Salamanca, 3¼ miles west of; bridge seat of iron girder bridge, southwest corner of. Bronze tablet marked "1,413 D"	1,412.523
Salamanca, 2.6 miles west of; top of rail at road crossing	1,399.4
West Salamanca flag station, top of rail at.....	1,371.3.

	Elevation.
Salamanca, top of rail at Erie station.....	1,386.2
Salamanca, Union school building on Maple street at; in water table at right of main entrance. Bronze tablet marked "1,390 D".....	1,390.233
(Originally set in 1897 and marked "1,396 S.")	
Salamanca, .8 mile east of; top of rail at road crossing.	1,396.2
Kill Buck, top of rail at flag station.....	1,384.3
Carrolton, top of rail at station.....	1,389.6
Carrolton, 475 feet east of Erie station at; west pier of B., R. & P. Ry iron bridge crossing over Erie tracks. Bronze tablet marked "1393 D.".....	1,393.389
Carrolton, .8 mile east of; top of rail at road crossing.	1,390.3
Carrolton, 1.8 miles east of; top of rail at road cross- ing.....	1,399.3
Vandalia, Erie station, top of rail at.....	1,406.4
Vandalia, 900 feet east of Erie station at.....	1,407.3
Allegany, 1.8 miles west of Erie station at; stone arch culvert under Erie railway, 75 feet east of road crossing, south end of, next to top step. Bronze tablet marked "1408 D." Originally set in 1897 and marked "1415 S.".....	1,407.696
Allegany, $\frac{3}{4}$ mile west of; top of rail at first road cross- ing.....	1,420.3
Allegany, .4 mile west of; top of rail at road crossing.	1,414.8
Allegany, top of rail at Erie station at.....	1,414.4
Olean, .8 mile west of Erie station; 90 feet north of Erie track at road crossing; top of spindle of hy- drant.....	1,417.290
Olean, .2 mile west of Erie station; top of rail at cross- ing of W. N. Y. & P. R. R. and Erie R. R.....	1,428.9
Olean, top of rail at Erie station at.....	1,429.0
Olean, .3 mile east of Erie station at; top of rail at...	1,430.3
Olean, city hall and P. O. building on State street at; northwest corner of; stone next under water table. Bronze tablet marked "1450 D." Originally set in 1896 and marked "1457".....	1,450.571

	Elevation.
Olean, 1 mile east of Erie station at; top of rail at road crossing	1,444.6
Olean, 1 $\frac{1}{4}$ miles east of; top of rail opposite mile post post " J. C. 393, -D. 66 "	1,448.5
Olean, 2 $\frac{3}{4}$ miles east of; top of rail opposite mile post " J. C. 392,—D. 67 "	1,456.3
Olean, 3 $\frac{3}{4}$ miles east of; top of rail opposite mile post " J. C. 391, D. 68 "	1,469.7
Hinsdale, 1.1 miles west of; top of outer rail at road crossing	1,480.5
Hinsdale, top of rail at Erie station	1,492.1
Hinsdale, .4 mile east of Erie station at; top of rail at road crossing	1,482.3
Hinsdale, 1 $\frac{1}{4}$ miles east of; top of rail at road crossing	1,493.3
Hinsdale, 2 miles east of; top of rail at road crossing	1,508.1
Hinsdale, 2 $\frac{1}{4}$ miles east of; bridge seat of small girder bridge 9 $\frac{1}{2}$ feet northwest of center of track. Bronze tablet marked " 1508 D."	1,508.079
Cuba, 2 $\frac{3}{4}$ miles west of Erie station west of; top of rail opposite mile post " J. C. 385, D. 74 "	1,518.3
Cuba, 1 $\frac{1}{2}$ miles west of; top of rail at road crossing	1,521.3
Cuba, 1 mile west of; top of outer rail of curve at road crossing	1,525.0
Cuba, top of north rail at Erie station	1,533.6
Cuba, $\frac{1}{2}$ mile east of Erie station at; south end of pier of stone arch bridge over Union street. Aluminum tablet marked " 1515 D." (Originally a bronze tablet set in 1896 and marked " 1522 ")	1,515.590
Cuba, 1.1 miles east of; top of rail center of bridge crossing over highway	1,553.3
Cuba, 1 $\frac{1}{4}$ miles east of; top of rail at road crossing	1,581.2
Cuba, 2.6 miles east of; top of rail at road crossing	1,611.9
Cuba, 3 miles east of; top of rail at road crossing	1,630.8
Cuba, 4.7 miles east of; top of north rail, main track, opposite " Q. X." tower. Summit of grade	1,689.2

	Elevation.
Friendship, $3\frac{1}{4}$ miles west of; top of north rail at road crossing	1,669.8
Friendship, $2\frac{3}{4}$ miles west of; top of rail at road crossing	1,644.7
Friendship, $1\frac{1}{4}$ miles west of; top of rail at road crossing	1,600.3
Friendship, 1.6 miles west of; top of north rail at road crossing	1,594.1
Friendship, $\frac{3}{4}$ mile west of; top of rail at road crossing	1,561.1
Friendship, $\frac{1}{2}$ mile west of; top of rail at road crossing	1,547.7
Friendship, top of south rail at Erie station	1,530.7
Friendship, Union school building at; water table at right of main entrance. Aluminum tablet marked "1520 D."	1,519.814
Friendship, 1.7 miles east of; top of rail center of bridge over highway	1,464.3
Friendship, $2\frac{3}{4}$ miles east of; top of rail at road crossing	1,427.0
Friendship, 2.85 miles east of; top of rail at road crossing	1,423.8
Belvidere, 1 mile west of; top of rail at road crossing	1,406.0
Belvidere, top of north rail at Erie station	1,377.3
Belvidere, .4 mile east of; top of north rail of road crossing	1,365.1
Belvidere, $\frac{3}{8}$ mile east of; south end of wing wall of abutment at east end of railway bridge over Van Campen creek, 28 feet south of center of track. Bronze tablet marked "1351 D."	1,351.065
Belvidere, .7 mile east of; top of rail at road crossing	1,355.3
Belmont, $\frac{1}{2}$ mile west of; top of rail at road crossing	1,374.6
Belmont, .3 mile west of; top of rail at road crossing	1,380.7
Belmont, southeast corner of Allegany county jail, in stone foundation. Aluminum tablet marked "1416 D."	1,416.599

	Elevation.
Belmont, top of south rail at Erie station.....	1,383.4
Belmont, Erie station at; 575 feet east of; top of north rail at road crossing.....	1,385.0
Belmont, 2 miles east of; top of rail at road crossing.	1,421.8
Belmont, 2.2 miles east of; top of north rail at road crossing.	1,423.5
Scio, 2 miles west of; top of north rail at road cross- ing.	1,423.5
Scio, 1½ miles west of; top of north rail at road cross- ing.	1,430.1
Scio, 1 mile west of; top of north rail at road crossing.	1,439.2
Scio; top of south rail at Erie station.....	1,452.8
Scio, 680 feet east of Erie station at; top of north rail at road crossing.....	1,453.7
Scio, .4 mile east of; top of north rail at road crossing.	1,455.4
Wellsville, .6 mile west of Erie station; top of north rail at road crossing.....	1,513.0
Wellsville; top of north rail at east end of Erie sta- tion.	1,518.2
Wellsville, Union school building at; northeast corner entrance; in footstone of arch over entrance; aluminum tablet marked "1,519 D".....	1,519.356
Wellsville, 1.8 miles east of; top of rail at road cross- ing.	1,524.0
Wellsville, 2.0 miles east of; top of rail at road cross- ing.	1,527.7
Wellsville, 4.0 miles east of; top of north rail at road crossing.	1,544.2
Andover, 3 miles west of; iron girder, railroad bridge No.8, stone step of; bronze tablet marked "1,573 D"	1,573.062
Andover, 2¼ miles west of; top of rail at road crossing	1,608.5
Andover; top of south rail at main track opposite Erie station.	1,648.9
Andover, .2 mile east of; top of north rail at road crossing.	1,655.6

	Elevation.
Andover, $\frac{1}{8}$ mile east of; top of north rail at road crossing.	1,662.7
Andover, 2 miles east of; stone foundation at southeast corner of small railway bridge. Bronze tablet marked "1,675 D"	1,674.970
Andover, $3\frac{1}{4}$ miles east of; top of north rail at road crossing.	1,724.8
Andover, 4 miles east of; top of north rail at road crossing.	1,756.5
Andover, $4\frac{1}{2}$ miles east of; top of south rail opposite water tank at Tip Top Summit.	1,771.9
Alfred, 3 miles west of; top of north rail at road crossing.	1,766.5
Alfred, $1\frac{1}{2}$ miles west of; top of north rail at road crossing.	1,693.9
Alfred, .4 mile west of; top of north rail at east end of bridge No. 4 over road and creek.	1,626.5
Alfred; top of north rail opposite Erie station.	1,606.4
Alfred; Erie railway station; water table under front office window facing track. Aluminum tablet marked "1,610 D"	1,610.267
Alfred, 1.6 miles east of; top of north rail center of bridge 2 over highway.	1,525.1
Almond; top of rail opposite center of Erie railway station.	1,393.8
Almond, 950 feet east of Erie railway station; bridge foundation at northwest corner of small railroad bridge over highway. Aluminum tablet marked "1,383 D"	1,381.800
Hornellsville, Erie railway station .6 mile; top of rail at street crossing	1,170.4
Hornellsville; top of rail opposite center of Erie railway station	1,155.5
Hornellsville, .7 mile east of Erie railway station; foundation wall at northeast corner of iron railway bridge. Aluminum tablet marked "1,141 D"	1,141.378

	Elevation.
Hornellsville, 2.9 miles east of; top of north rail at road crossing	1,133.3
Canisteo; top of south rail opposite center of Erie station.	1,126.7
Canisteo, $1\frac{1}{2}$ miles east of; top of north rail at road crossing.	1,124.2
Canisteo, $1\frac{1}{2}$ miles east of; top of north rail at road crossing.	1,123.4
Canisteo, 2.1 miles east of; bridge seat of iron girder bridge No. 87, northeast corner of; aluminum tablet marked "1,113 D"	1,113.007
Adrian; top of south rail at center of Erie station.	1,100.4
Adrian, 3.7 miles east of; in face of rock cliff on east side of Erie railway and highway; 400 feet northeast of highway bridge across Canisteo river; 25 feet from east rail. Bronze tablet marked "1,080 D"	1,080.117
Adrian, $3\frac{3}{4}$ miles east of; top of north rail at road crossing.	1,072.3
Cameron, $2\frac{1}{4}$ miles west of; top of north rail at road crossing.	1,056.1
Cameron, $\frac{3}{4}$ mile west of; top of south rail at road crossing.	1,054.8
Cameron; top of north rail at center of Erie station.	1,046.5
Cameron, 180 feet west of Erie station at; in stone foundation of railroad water tank. Bronze tablet marked "1,048 D"	1,047.865
Cameron, $\frac{3}{4}$ mile east of; top of north rail at road crossing.	1,040.7
Cameron Mills; top of north rail opposite center of Erie station at	1,032.0
Cameron Mills; 270 feet east of Erie station at; top of north rail at road crossing.	1,032.0
Bathbone, $2\frac{1}{2}$ miles west of; top of north rail at road crossing.	1,021.6
Bathbone, 2 miles west of; top of rail at road crossing	1,019.5

	Elevation.
Rathbone, $\frac{1}{2}$ mile west of; top of north rail at road crossing.	1,007.5
Rathbone; general merchandise store of F. G. Martin (building owned by O. O. Whittemore), foundation stone at right of main entrance. Bronze tablet marked "1,006 D"	1,006.010
Rathbone; top of south rail opposite center of Erie station.	1,007.3
Rathbone, $1\frac{1}{2}$ miles east of; top of north rail at road crossing	991.7
Addison, top of north rail of west-bound track opposite center of Erie station.	984.2
Addison, .4 mile east of Erie station and 750 feet northwest of tracks; Union school building, at right of main entrance to. Aluminum tablet marked "1,021 D"	1,021.530
Addison, .9 mile east of Erie station; top of north rail of west-bound track at road crossing.	979.0
Erwins, 1.9 miles west of; top of north rail of west-bound track at road crossing.	972.3
Erwins station; top of south rail of east-bound track opposite center of.	963.9
Erwins, top of north rail of west-bound track at road crossing.	944.9
Painted Post, .8 mile west of; in masonry wall of open culvert, east wall of culvert and south side of railroad track. Bronze tablet marked "935 D"	935.180
Painted Post, top of south rail of east-bound track opposite center of Erie station.	937.1
Painted Post, .6 mile east of; top of north rail of west-bound track at road crossing.	936.1
Corning, top of rail opposite center of Erie station.	935.0
Corning, City Hall at corner of Erie avenue and Cedar street; foundation stone under water table at right of Cedar street entrance.	935.757

	Elevation.
Corning, $1\frac{1}{4}$ miles east of; top of north rail of west-bound track at road crossing.....	921.9
East Corning, $1\frac{1}{2}$ miles west of; top of north rail at road crossing	914.8
East Corning, top of south rail opposite center of Erie station at	907.9
Big Flats, $1\frac{1}{4}$ miles west of; in bridge seat at Erie Railway bridge No. 67 A, at southwest corner of. Bronze tablet marked "899 D".....	899.822
Big Flats, .6 mile west of; top of north rail of west-bound track in center of bridge No. 66, over highway	905.9
Big Flats, top of south rail of west-bound track opposite center of Erie station.....	909.5
Big Flats, 1 mile east of; top of south rail of west-bound track under overhead road crossing.....	916.4
Big Flats, 2.4 miles east of; top of north rail of west-bound track under overhead road crossing.....	925.3
Horseheads, $\frac{3}{4}$ mile west of; top of north rail of west-bound track at road crossing.....	911.1
Horseheads, $\frac{1}{8}$ mile west of; top of north rail of west-bound track at road crossing.....	906.0
Horseheads, top of north rail of west-bound track opposite center of Erie station.....	902.0
Horseheads, .35 mile southwest of Erie station; on pier of Lackawanna Railway bridge at crossing of Northern Central Railway, 50 feet south of center of north-bound track of Northern Central Railway. Aluminum tablet marked "901 D".....	901.129
Horseheads, Northern Central Railway station; northeast corner of stone doorsill of men's waiting room..	899.132
Horseheads, $1\frac{1}{2}$ miles east of Erie station; top of north rail of west-bound track at road crossing.....	889.9
Horseheads, 2 miles east of; top of south rail of west-bound track at road crossing.....	880.3

	Elevation.
Elmira, 2 miles west of; top of south rail of west-bound track at road crossing.....	873.1
Elmira, Erie station; top of south rail of east-bound track opposite distance board.....	856.0
Elmira, City Hall corner of Church and Lake streets; stone pedestal of lamp post at left of Lake street entrance. Aluminum tablet marked "857 Albany".	857.650
Elmira, $\frac{1}{2}$ mile east of Erie station at; chisel mark + on head of iron bolt set in stone foundation at west end of Erie Railway bridge across Chemung river. Bolt in between tracks and nearest east bound track.....	853.618
Wellsburg station, 1 mile west of; top of north rail of west-bound track at road crossing.....	826.0
Wellsburg station, 1,800 feet west of; coping stone of abutment wall at southeast corner of bridge No. 55. Aluminum tablet marked "824 A".....	822.233
Wellsburg station, top of south rail of east-bound track opposite center of.....	824.5
Wellsburg, 1.8 miles east of; top of north rail of west-bound track at road crossing.....	816.0
Chemung station, 1 mile west of; coping stone of abutment wall at northeast corner of bridge No. 53 across Chemung river. Aluminum tablet marked "804 A.".	802.110
Chemung, top of north rail of west-bound track at center of Erie station.....	810.6
Waverly, $3\frac{1}{2}$ miles west of; top of south rail of west-bound track at road crossing.....	809.3
Waverly, 1.2 miles west of Erie station at; top of north rail of east-bound track at center of bridge crossing over road	816.9
Waverly, top of north rail of west-bound track opposite center of Erie station.....	829.2
Waverly, City Hall building on Broad street; stone column between doorways. Aluminum tablet marked "840 A"	838.375

	Elevation.
Waverly, 1 mile east of Erie station; top of south rail of east-bound track at center of bridge crossing over Lehigh Valley Railroad.....	818.9
Waverly, 2 $\frac{3}{4}$ miles east of Erie station at; top of north rail of west-bound track at road crossing.....	809.2
Waverly, 3 miles east of Erie station at; top of north rail of west-bound track at crossing over highway...	804.9
Barton, 2.3 miles west of; top of north rail of west-bound track at road crossing.....	792.5
Barton, 1 $\frac{1}{2}$ miles west of; top of north rail of west-bound track at road crossing.....	792.1
Barton, top of north rail of west-bound track opposite center of Erie station.....	796.9
Barton, $\frac{1}{4}$ mile east of Erie station at; top of south rail of east-bound track at road crossing.....	796.9
Barton, 1.2 miles east of; coping stone of abutment at southeast corner of bridge No. 40. Aluminum tablet marked "798 A".....	796.559
Smithboro, top of south rail of west-bound track at center of Erie station.....	792.5
Smithboro, .2 mile east of Erie station; top of south rail of west bound track at road crossing.....	792.3
Smithboro, 2.1 miles east of; top of north rail of west bound track at overhead road crossing.....	793.8
Tioga Center, 1.1 miles west of; top of north rail of west bound track at road crossing.....	793.6
Tioga Center, top of south rail of west-bound track at center of Erie station.....	797.1
Tioga, 2 $\frac{1}{2}$ miles east of; top of north rail of west bound track at road crossing.....	807.9
Owego, 2 $\frac{1}{4}$ miles west of Erie station at; coping stone of abutment at southeast corner of bridge No. 37. Aluminum tablet marked "815 A".....	814.081
Owego, 1 $\frac{1}{4}$ miles west of Erie station at; top of north rail of west bound track at road crossing.....	812.1

	Elevation.
Owego, 700 feet west of Erie station at; top of north rail of west bound track at crossing of Ithaca branch of Lackawanna railway.....	815.9
Owego; top of north rail of west bound track at center of Erie station.....	816.2
Owego, .8 mile east of Erie station; top of north rail of west bound track at road crossing.....	813.7
Owego, 2.4 miles east of Erie station at; top of south rail of west bound track at road crossing.....	814.3
Owego, 2 $\frac{1}{4}$ miles east of Erie station at; coping stone at northwest corner of bridge No. 33. Aluminum tablet marked "812 A".....	810.744
Campville, 3 $\frac{1}{4}$ miles west of; top of north rail of west bound track at road crossing.....	816.4
Campville station; top of north rail opposite center of	824.3
Campville station, 1 mile east of; top of south rail of west bound track at road crossing.....	827.9
Union, 1.4 miles east of; coping stone of wing wall of abutment at northeast corner of bridge No. 31, across Nanticoke creek. Bronze tablet marked "825 A"	827.429
Union station, top of south rail of east bound track at center of	834.5
Hooper station, 1 $\frac{1}{4}$ miles west of; top of north rail of west bound track at road crossing.....	839.3
Hooper station, 1.2 miles west of; top of north rail of west bound track at road crossing.....	841.5
Hooper station, top of south rail of west bound track at	833.9
Hooper station, $\frac{1}{4}$ mile east of; top of south rail of west bound track under overhead farm crossing...	834.0
Hooper station, 1 mile east of; top of north rail of west bound track at road crossing.....	832.9
Lestershire, 1 $\frac{1}{4}$ miles west of; top of south rail of west bound track center of bridge No. 27, over highway.	839.3

	Elevation.
Lestershire, 1 mile west of; top of south rail of west bound track at center of bridge No. 26, over highway	840.5
Lestershire, top of south rail of east bound track at Erie station at	847.5
Lestershire, .3 mile east of Erie station at; top of south rail of east bound track under overhead road crossing	850.1
Binghamton station, 1.6 miles west of; top of south rail of east bound track at road crossing	854.4
Binghamton, Broome county courthouse, west end of at left of basement entrance from Collier street. Aluminum tablet marked "867 A"	865.144
Binghamton station (Erie & D. & H.), top of north rail of west bound track opposite center of	862.85
Binghamton station, 1 mile east of; top of south rail at crossing of D. & H. and S. B. & N. Y. Rys	851.9
Binghamton station, 1½ miles east of; top of south rail at road crossing	866.5
Binghamton station, 2¼ miles east of; top of south rail at center of bridge 108 over highway	899.0
Binghamton station, 3.1 miles east of; top of north rail at road crossing	937.4
Port Crane station, 3¼ miles west of; 900 feet west of road crossing. Parapet wall at east end of culvert under railway. Bronze tablet marked "959 A"	957.628
Port Crane station, 3 miles west of; top of south rail at road crossing	976.3
Port Crane station, 2-3 mile west of; top of south rail at road crossing	1,040.8
Port Crane station, top of north rail at	1,041.2
Sanitaria Springs, 1.9 miles west of; top of north rail at road crossing	1,041.4
Sanitaria Springs station, 1.3 miles west of; top of north rail at road crossing	1,063.4

	Elevation.
Sanitaria Springs station, $\frac{1}{2}$ mile west of; top of north rail at road crossing	1,098.1
Sanitaria Springs station, top of north rail at.....	1,116.4
Sanitaria Springs station, $\frac{1}{8}$ mile east of; coping stone of abutment at northeast corner of bridge No. 107 over highway. Bronze tablet marked "1,126 A"	1,124.748
Tunnel station, $4\frac{1}{4}$ miles west of; top of north rail at road crossing	1,173.8
Tunnel station, $3\frac{1}{4}$ miles west of; top of south rail over arch culvert; road passing underneath.....	1,232.2
Tunnel station, $1\frac{1}{2}$ miles west of; top of north rail at road crossing	1,331.3
Tunnel station, $\frac{1}{2}$ mile west of; coping stone of abutment at southeast corner of bridge No. 104, crossing over road. Bronze tablet marked "1,384 A".....	1,383.311
Tunnel station, top of north rail at.....	1,414.5
Tunnel station, .4 mile east of; top of rail at west portal of tunnel	1,434.4
Tunnel station, 2.3 miles east of; top of north rail at road crossing	1,343.38
Harpursville station, $2\frac{3}{4}$ miles west of; top of north rail at road crossing.....	1,225.2
Harpursville station, .9 miles west of; top of south rail at road crossing	1,097.8
Harpursville station, 1,250 feet west of; coping stone of abutment at southwest corner of iron trestle bridge No. 97. Bronze tablet marked "1,051 A"...	1,048.216
Harpursville station, top of north rail at.....	1,053.1
Nineveh station, top of north rail at.....	1,033.1
Afton station, $2\frac{3}{4}$ miles west of; top of north rail at road crossing	983.5
Afton station, top of north rail at.....	981.3
Afton station, 1,050 feet east of; coping stone of abutment at northeast corner of iron girder bridge No. 90 $\frac{1}{4}$, crossing over highway. Bronze tablet marked "973 A"	971.970

	Elevation
Afton, .85 mile east of; top of north rail at road crossing	994.0
Bainbridge, 2 miles west of; foundation stone at northeast corner of small cattle pass opening. Bronze tablet marked "978 A"	976.882
Bainbridge station, .6 mile west of; top of north rail at road crossing	986.7
Bainbridge station, top of north rail at	1,005.6
Bainbridge, 1 mile east of; top of north rail at road crossing	991.8
Bainbridge, 1 $\frac{3}{4}$ miles east of; top of north rail at road crossing	1,007.1
Bainbridge, 2.2 miles east of; top of north rail at road crossing	1,006.7
Bainbridge, 2 $\frac{3}{4}$ miles east of; coping stone of bridge abutment at southeast corner of bridge No. 84. Bronze tablet marked "989 A"	988.900
Bainbridge, 3 $\frac{1}{6}$ miles east of; top of north rail at road crossing	993.5
Sidney, D. & H. station, $\frac{1}{4}$ mile west of; top of rail at crossing of D. & H. and New York, Ontario and Western Railway	990.34
Sidney, D. & H. station, at top of south rail	992.5
Sidney, 1 mile east of; top of south rail at center of bridge No. 82, across Susquehanna river	1,002.2
Unadilla, D. & H. station at; $\frac{3}{4}$ mile west of; top of south rail at road crossing	1,016.5
Unadilla, D. & H. station at; $\frac{1}{8}$ mile west of; top of north rail at road crossing	1,016.3
Unadilla, D. & H. station at; top of south rail	1,024.46
Unadilla, Union school building at; foundation wall at left of main entrance to. Aluminum tablet marked "1,024 A"	1,022.572
Wells Bridge, 2 $\frac{1}{2}$ miles west of; top of south rail at road crossing	1,036.2

	Elevation.
Wells Bridge, .8 mile west of; top of south rail at road crossing	1,047.7
Wells Bridge, .3 mile west of; top of south rail at road crossing	1,053.3
Wells Bridge, D. & H. station at; about 300 feet west of; coping stone of abutment at northeast corner of highway bridge across Susquehanna river. Bronze tablet marked "1,047 A"	1,045.925
Wells Bridge, D. & H. station at; top of south rail....	1,048.9
Otego, .9 mile west of; top of south rail, bridge No. 69	1,051.5
Otego, D. & H. station; top of rail at.....	1,063.3
Otego, 1 mile east of; southeast corner of culvert, third step from top. Bronze tablet marked "1,051 A"..	1,049.433
Otego, 1.6 miles east of; top of south rail at road crossing	1,057.9
Otego, 2 miles east of; top of south rail at road crossing	1,061.4
Otego, 2 $\frac{1}{4}$ miles east of; top of north rail center of bridge No. 64, across Susquehanna river.....	1,064.0
Oneonta, 4 $\frac{1}{2}$ miles west of; top of north rail at road crossing	1,058.9
Oneonta, 3 $\frac{1}{2}$ miles west of; top of north rail at road crossing	1,065.6
Oneonta, 3 miles west of; top of north rail at road crossing	1,067.8
Oneonta, 1.8 miles west of; top of north rail at road crossing	1,066.4
Oneonta, D. & H. station, .9 mile west of; top of rail at road crossing	1,077.6
Oneonta State Normal School; in face of west pillar at main entrance of. Aluminum tablet marked "1,232 A"	1,231.221
Oneonta, D. & H. station; top of north rail at.....	1,083.3
Oneonta, D. & H. station; southwest corner of door-sill of door into waiting room and dining hall. Door faces track and is east of office window.....	1,085.791

	Elevation.
Colliers, 2 $\frac{1}{4}$ miles west of; top of north rail at road crossing	1,122.5
Colliers, top of rail at D. & H. station at	1,118.7
Colliers, 700 feet east of; bridge No. 54, across Susquehanna river; northeast corner of coping stone of east abutment. Bronze tablet marked "1119 A."	1,117.835
Cooperstown junction, .6 mile west of; top of north rail at road crossing	1,119.1
Cooperstown junction, top of north rail at	1,126.7
Maryland, 1.9 miles west of; southeast corner of bridge No. 51, across Schenevus creek. Parapet wall. Bronze tablet marked "1170 A."	1,169.210
Maryland, 1 $\frac{1}{2}$ miles west of; top of north rail at road crossing	1,171.7
Maryland, D. & H. station, top of north rail at	1,212.8
Schenevus, 1.9 miles west of; top of north rail at road crossing (Chaseville)	1,219.7
Schenevus, 1.6 miles west of; top of north rail at road crossing	1,225.1
Schenevus, D. & H. station, .6 mile west of; top of north rail at road crossing	1,249.8
Schenevus, D. & H. station, top of south rail at	1,275.7
Schenevus, D. & H. station, $\frac{1}{4}$ mile east of; coping stone of abutment at southeast corner of bridge across Schenevus creek. Bronze tablet marked "1272 A."	1,270.768
Schenevus, 2 miles east of; top of north rail at road crossing	1,307.2
Worcester, 1.9 miles west of; top of north rail at road crossing	1,318.6
Worcester, D. & H. station; 80 feet west of west end of; railroad water tank foundation. Third course of stone east side of bank. Aluminum tablet marked "1311 A."	1,309.560
Worcester, D. & H. station at; top of north rail	1,305.9
Worcester, $\frac{3}{8}$ mile east of; top of north rail at road crossing	1,333.3

	Elevation.
Worcester, 1.1 miles east of; top of north rail at road crossing	1,353.8
East Worcester, 2½ miles west of; top of north rail at road crossing	1,400.6
East Worcester, ¾ mile west of; center pier of railroad bridge or large culvert; capstone at north end. Aluminum tablet marked "1406 A."	1,404.624
East Worcester, D. & H. station at; top of north rail.	1,434.0
East Worcester, .8 mile east of; top of north rail at road crossing	1,446.9
East Worcester, 2.3 miles east of; top of north rail at summit of grade	1,503.6
Richmondville, 2.2 miles west of; top of north rail at road crossing. (Carrollville flag station.)	1,378.7
Richmondville, 1.8 miles west of; top of rail in center of bridge No. 33 over highway	1,351.2
Richmondville, 1 mile west of; top of north rail at road crossing	1,295.5
Richmondville, .6 mile west of; D. & H. Ry. bridge No. 31; coping stone of east abutment wall at northeast corner of bridge. Bronze tablet marked "1224 A." . .	1,222.502
Richmondville, D. & H. station at; top of south rail. .	1,185.4
Richmondville, 1½ miles east of; top of north rail on bridge 31 over highway	1,079.0
Cobleskill, 1.9 miles west of; top of north rail at road crossing	984.7
Cobleskill, 1½ miles west of; top of north rail at road crossing	979.7
Cobleskill, 1 mile west of; [] chisel mark on south end of culvert at west side of road crossing. (Temporary B. M. set by Clark Brown)	948.686
Cobleskill, .6 mile west of; top of north rail of road crossing	935.6
Cobleskill Union school building; stone foundation at northwest corner of. Bronze tablet marked "930 A" .	929.076
Cobleskill; D. & H. station; top of north rail at	908.6

	Elevation.
Cobleskill, .9 mile east of; top of north rail at road crossing.	888.8
Barnerville Crossing, [] chisel mark on rock 50 feet north of railroad at. (Set by Clark Brown.)	903.320
Barnerville Crossing, top of north rail at.	905.6
Howe's Cave, 2¼ miles west of; top of north rail under overhead farm crossing	923.0
Howe's Cave, 1½ miles west of; top of north rail at road crossing.	885.9
Howe's Cave, D. & H. station; top of south rail at. . . .	794.9
Howe's Cave, ¼ mile east of; top of north rail at road crossing.	782.6
Howe's Cave, 1.2 miles east of; bridge seat at north-west corner of small bridge or open culvert. Bronze tablet marked "731 A"	730.231
Central Bridge, 1-3 mile west of; top of north rail at road crossing	641.2
Central Bridge, D. & H. station; top of north rail opposite.	620.8
Schoharie Junction, D. & H. station; top of north rail opposite.	598.3
Schoharie Junction, 1.2 miles east of; top of north rail at road crossing	636.4
Schoharie Junction, 1.3 miles east of; top of north rail at road crossing.	642.4
Esperance, .9 mile west of; top of north rail at road crossing.	725.0
Esperance, D. & H. station; 1,250 feet west of; coping stone at north end of stone culvert under D. & H. railway. Bronze tablet marked "753 A"	751.968
Esperance, D. & H. station, top of north rail at.	767.5
Esperance, 1 mile east of; top of north rail at road crossing.	811.7
Delanson, D. & H. station; 1.9 miles west of; top of rail at road crossing.	436.9
Delanson, D. & H. station; top of south rail at.	812.0

	Elevation.
Delanson, .6 mile east of; top rail at road crossing....	803.8
Delanson, 1½ miles east of; top of north rail at private road crossing.	796.9
Duanesburg, D. & H. station, 1,000 feet west of; north end of east abutment. Bronze tablet marked " 681 A "	680.374
Duanesburg, D. & H. station; top of south rail opposite.	676.1
Duanesburg, .6 miles east of; top of south rail at road crossing.	660.3
Duanesburg, 1½ miles east of; top of south rail at road crossing	588.2
Kelleys, 2 miles west of; top of south rail at road crossing.	556.9
Kelleys station, base of rail at.....	490
Kelleys, 1 mile east of; top of rail at private road crossing.	450.4
Kelleys, 1.6 miles east of; top of rail at road crossing.	419.0
Kelleys, 1½ miles east of; coping stone at east abutment of cattle and wagon pass; 750 feet east of highway. Bronze tablet marked " 410 A ".....	408.575
South Schenectady, ½ mile southwest of; top of rail at road crossing	352.5
South Schenectady, top of rail at road crossing .2 mile southwest of station.....	349.3
South Schenectady, top of rail at road crossing at West Shore and D. & H. railways.....	548.7
Schenectady, 2½ miles southwest of; top of north rail at road crossing.....	320.0
Schenectady, D. & H. station; ¾ mile south of; top of rail under center of bridge. N. Y. Central crossing over D. & H. railway.....	225.8
Schenectady, N. Y. Central & Hudson R. R. bridge over Erie canal. Northeast corner of coping stone of abutment wall. Bronze tablet marked " 242 A ".	240.777

TABLE.

Total Areas of Towns, the Topographic Survey of which has been Fully Completed, with Names of Published Atlas Sheets on which they Appear.

TOWN.	County.	Area square miles.	Atlas sheets.	Remarks.
Adams	Jefferson	43.15	Sacketts Harbor, Watertown	Including Adams village.
Athens	Greene	28.18	Coxsackie, Catskill	Including Athens village.
Ballston	Saratogo	31.2	Schenectady	Including part of Ballston Spa.
Bedford	Westchester ..	41.17	Carmel, Stamford	Including parts of Katonah and Mt. Kisco villages
Beekman	Dutchess	31.31	Clove, Poughkeepsie .....	.....
Berlin	Rensselaer	59.86	Berlin .....	.....
Big Flats	Chemung	45.23	Elmira .....	.....
Brownville	Jefferson	21.11	Sacketts Harbor	Including Brownville and Dexter villages.
Brunswick	Rensselaer	43.6	Cohoes, Troy .....	.....
Buffalo	Erie	39.4	Buffalo .....	.....
Cairo	Greene	61.05	Coxsackie, Catskill, Durham, Kaaterskill .....	.....
Cambria	Niagara	39.40	Tonawanda .....	.....
Carmel	Putnam	39.55	Carmel, West Point .....	.....
Catskill	Greene	64.35	Coxsackie, Catskill, Kaaterskill ..	Including Catskill and Palenville village.
Chesterfield	Essex	112.6	Ausable, Plattsburg, Willsboro ..	Including parts of Clintonville and Keeseville villages.
Cicero	Onondaga	48.29	Chittenango, Syracuse	Including Brewerton village.
Clarkstown	Rockland	41.66	Ramapo, Tarrytown	Including Upper Nyack village.
Clermont	Columbia	19.11	Catskill .....	.....
Clifton Park	Saratoga	52.3	Schenectady .....	.....
Clinton	Dutchess	38.47	Rhinebeck .....	.....
Coeymans	Albany	52.57	Albany, Coxsackie .....	.....
Cortlandt	Westchester ..	45.63	Tarrytown, West Point	Including Peekskill and Verplanck villages.
Coxsackie	Greene	39.51	Coxsackie	Including Coxsackie village.

Total Areas of Towns, Etc.—(Concluded.)

TOWN.	County.	Area, square miles.	Atlas sheets.	Remarks.
New Baltimore	Greene	42.37	Coxsackie	Including New Baltimore village.
New Castle	Westchester ..	26.15	Stamford, Tarrytown	Including Chappaqua village and part of Mt. Kisco village.
Newfield	Tompkins	59.3	Ithaca .....	.....
Niagara	Niagara	28.51	Tonawanda, Niagara Falls .....	.....
Niskayuna	Schenectady ..	17.6	Schenectady .....	.....
North Castle	Westchester ..	26.78	Stamford, Tarrytown .....	.....
North Greenbush	Rensselaer	21.8	Troy	Including Bath-on-Hudson village.
North Salem	Westchester ..	23.50	Carmel .....	.....
North Tonawanda village ..	Niagara	9.83	Tonawanda .....	.....
Nyack village	Rockland	1.62	Tarrytown .....	.....
Orangetown	Rockland	23.47	Ramapo, Tarrytown	Including Nyack, Piermont, South Nyack and Sparkill villages.
Ossining	Westchester ..	12.47	Tarrytown	Including Sing Sing village.
Patterson	Putnam	32.11	Carmel, Clove .....	.....
Pawling	Dutchess	45.62	Clove	Including Pawling village.
Pelham	Westchester ..	5.1	Harlem	Including City Island village.
Phillipstown	Putnam	50.71	West Point	Including Cold Spring and Nelsonville vil- lages.
Poestenkill	Rensselaer	32.55	Berlin, Troy .....	.....
Poughkeepsie	Dutchess	37.21	Poughkeepsie	Town and city, including part of Wappinger Falls village.
Poundridge	Westchester ..	23.51	Carmel, Stamford .....	.....
Putnam Valley	Putnam	43.54	West Point .....	.....
Ramapo	Rockland	58.85	Ramapo	Including Spring Valley village.
Red Hook	Dutchess	39.28	Catskill, Rhinebeck	Including Red Hook and Tivoli village.
Rhinebeck	Dutchess	39.48	Rhinebeck	Including Rhinebeck village.
Rodman	Jefferson	42.58	Watertown .....	.....
Salem	Washington ..	53.2	Cambridge	Including Salem village.

Sand Lake	Rensselaer	26.89	Berlin, Troy .....	..... Including Lacona and Sandy Creek villages.
Sandy Creek	Oswego	46.77	Pulaski .....	..... Including Saugerties village.
Saugerties	Ulster	68.26	Catskill, Kaaterskill .....	.....
Scarsdale	Westchester	6.25	Harlem, Tarrytown, Oyster Bay .....	.....
Somers	Westchester	32.91	Carmel, West Point, Stamford, Tarrytown .....	.....

REPORT

OF

Assistant Engineer C. H. Flanigan.

REPORT.

ALBANY, N. Y., *December 29, 1898.*

HON. CAMPBELL W. ADAMS, *State Engineer and Surveyor:*

Sir.—I have the honor to submit this my report on the survey of the New York and Massachusetts boundary line, executed during the years 1897 and 1898.

It might prove interesting to briefly review the early history of the line and the causes leading to its establishment before taking up an account of the present work.

King James I granted by Letters Patent in 1620, November 3, to "The Council established at Plymouth in the County of Devon for the planting, ruling, ordering and governing of New England in America . . . all that part of America lying and being in breadth from forty degrees of Northerly latitude from the equinoxtiall line, to forty eight degrees of said Northerly latitude, exclusively, and in length of and within all the breadth aforesaid, throughout the maine lands, from sea to sea, together also with all firme lands, soyles, grounds, havens, ports, rivers, waters, fishing, mines and mineralls, as well royall mines of gould and silver as other mines and mineralls, precious stones, quarries and all and singular other commodities, jurisdiction, royalties, privileges, franchises and preliminaries, both within the said tract of land upon the maine, and also within the islands and seas adjoining: Provided always that the said islands or any the premises hereinbefore mentioned, and by these presents intended and meant to be granted, be not actually possessed or inhabited by any other Christian Prince or State, nor within that Southern Colonies heretofore by us granted to be planted by divers of our loving-subjects in the south part."

This proviso applied to the possessions of the Dutch along and near the Hudson river. In 1628 March 19, the Council con-

veyed to Sir Henry Roswell and his associates "all that parte of Newe England in America which lyeth and entendeth between a great River there commonlie called Monomack alias Merrimack River, and a certen other River there, called Charles River, being in the Bottome of a certen Bay there commonlie called Massachusetts. . . . and all lands and Hereditaments whatsoever lyeing within the lymits aforesaid, North and South in Latitude and Breadth, and in Latitude and Longitude, of and within all the Bredth aforesaid, throughout the Mayne Lands there from the Atlantick and Western Sea and Ocean on the East Parte to the South Sea on the West Parte."

A charter was granted in 1629 4th March by Charles I, covering the same lands, with the proviso excepting lands actually possessed or inhabited by any other Christian Prince or State. The south bounds of this grant were afterwards found to be in latitude 42°02' north, which is the latitude of the present north boundary of Connecticut.

In 1664 Charles Second granted to his brother James, Duke of York, certain lands in New England "together alsoe with the said River called Hudsons River and all the land from the west side of Connecticut River to the east side of De la Ware Bay." No boundary on the west was given although the presumption is that the western limit was the Delaware river. To remove all questions of doubt as to the validity of the Duke's title a second grant covering the same lands was made to him ten years later.

The High Court of Chancery of England in 1684 ruled that the Massachusetts charter of 1629 given by Charles First was void. The validity of the deed given under this charter was apparently not affected by this ruling, although the New York Council in 1753 maintained that the charter under which the deed was given being void in itself would include the deed in its effects.*

Upon the application of the agents of the colonists a new charter was granted October 7, 1691, incorporating the colonies of Massachusetts and New Plymouth, Maine and Nova Scotia into

* N. Y. Council Minutes (MS.), xxiii, 55.

“one real province by the name of our province of the Massachusetts Bay in New England.” This new province included “all that part of New England in America lying and extending from the great river commonly called Monomack alias Merrimac, on the North part and from three miles northward of the said river to the Atlantick or Western Sea or Ocean in the South part and all the lands and hereditaments whatsoever, lying within the limits aforesaid and extending as far as the outermost points or promintories of land called Cape Cod, and Cape Malabar north and south and in latitude breadth, and in length and longitude, of and within all the breadth and compass aforesaid, throughout all the mainland there, from the said Atlantic or Western Sea and Ocean, on the East part, towards the South Sea or Westward as far as our Colonies of Rhode Island, Connecticut, and the Narraganset Country.” . . .

From this it is seen that the Colony was limited toward the west by the western boundary of Connecticut. This boundary had been fixed by agreement November 30, 1664,* between Commissioners representing the Duke of York and Delegates from the Colony and was not “to extend into any part of the maine Land further west ward than the head of a Creeke or River at high water marke commonly called by the Indian name Mameronock and from thence by a direct line to the North North West till it meet with the Massachusetts line, nearer than the distance of Twenty Miles from any of the borders of the Maine River Commonly called Hudsons River.” . . . This agreement was ratified November 28, 1683, by Thomas Dongon, Governor of New York, and by Robert Treat, Governor of Connecticut and the Commissioners of Connecticut.†

The first effort that was made to have the boundary line between the two provinces actually run was in a bill passed by the Massachusetts General Court November, 1719, calling for the appointment of “a committee to join with such as the government of New York shall appoint to run and settle the divisional line and boundary between the s’d provinces.” In reply to this.

* N. Y. Col. MSS., 1x1x, 4.

† N. Y. Col. MSS., 1x1x, 10.

offer no action was taken by the New York Assembly, and nothing further was attempted in the matter until 1754, when on account of serious troubles that were occurring between the inhabitants of the two provinces in the vicinity of the disputed boundary some determined action became necessary. In that year a commission with stipulated powers, consisting of four members, was appointed by New York "to act in conjunction with commissioners on the part of the Province of Massachusetts Bay to settle, agree upon, fix and ascertain the bounds between the said two provinces, or provisional or temporary bounds between the said governments to be deemed the line of jurisdiction and limits until the true bounds shall be finally settled."

A like commission was appointed by the Province of Massachusetts Bay, with its powers limited to the settling of a permanent line.

At the meeting of this joint commission, the New York members proposed that the Connecticut river should be the divisional line, basing their claim on the letters patent granted by King Charles the Second to James Duke of York, bearing date March 12, 1664. This proposition was rejected by the Massachusetts commissioners; they instead proposing "a line twelve miles eastward of Hudsons river." As neither side would recede from its first proposition the commission adjourned leaving the question of the location of the line in the same unsatisfactory and intangible condition as before.

In 1767 a joint commission was again appointed by the two provinces and met at New Haven, Conn., September 30th of that year. At that meeting the final proposition of the Massachusetts commission was "that a straight line to be drawn northerly to a point on the south boundary line of Massachusetts Bay twenty miles due east from Hudsons river to another point distant twenty miles due east from the same river, on that line which divided the Province of Massachusetts Bay from New Hampshire be the eastern boundary of the Province of New York." As the general direction of the Hudson river is considerably to the east of north, the New York commissioners objected to a line

drawn through two points twenty miles distant due east from the river on the ground that such a partition would give Massachusetts jurisdiction within twenty miles of the Hudson, measuring at right angles therefrom; and instead proposed "that the two provinces be divided by a straight line from the southern to the northern boundary line of Massachusetts; to begin on the south at the northwest corner of the oblong fixed by New York and Connecticut, to be twenty miles from Hudsons river and run to a point twenty miles from the said river in the line between Massachusetts Bay and New Hampshire, to be found by running a line perpendicular to the main course of that river between the north and south lines of the Massachusetts Bay extended thereto."

Like the preceding commission neither side would accept the proposal of the other and for a second time the evident hopes which were entertained by both governments for the settling of the jurisdictional line and for a stopping of the quarrels and contentions and riots which were now common among the "borderers" came to naught.

By act of the New York Assembly, passed March 28, 1773, commissioners were appointed "to settle a line or lines of jurisdiction between this colony and the Province of Massachusetts Bay." Commissioners with like powers having been appointed by Massachusetts, the joint commission met at Hartford, where it was unanimously agreed that "a line beginning at a place fixed upon by the two governments of New York and Connecticut, in or about the year of our Lord one thousand seven hundred and thirty-one, for the northwest corner of a tract of land commonly called the Oblong or equivalent land, and running from the said corner north twenty-one degrees, ten minutes and thirty seconds east as the magnetic needle now points to the north line of the Massachusetts Bay shall at all times hereafter be the line of jurisdiction between the said province of Massachusetts Bay and the said Province of New York in all and every part and place where the said Province of New York on its eastern boundary shall adjoin on the said Province of Massachusetts."

The course north twenty-one degrees, ten minutes and thirty seconds east is the general course of the Hudson river as determined by survey in the winter of 1772.

A surveying party was at once organized to carry out the terms of the agreement and it seemed that at last this line which had been the cause of debate for over a century was finally to be fixed. Starting from the northwest corner of the oblong the survey had proceeded about six miles when, owing to local attraction, a doubt arose as to whether the line was being run on the agreed upon course, it was then mutually decided to run the rest of the line by "stakes and back sights," although it was known that such a line would tend more easterly than a line run by the needle, as the needle by an increase of variation in going towards the north would describe a curve going westerly. The survey, however, was continued in this manner until it had reached a point twenty miles from the beginning where it was abruptly terminated owing to the refusal of one of the commissioners to consent to the further prolongation of the line except in absolute compliance with the terms of the Hartford agreement.

The troublesome days of the Revolution coming on about this time, no further attempt was made to establish the boundary until 1783 when for a fourth time commissioners were appointed by each State "to complete the running of a jurisdictional line between the State of New York and the State or Commonwealth of Massachusetts." Like their predecessors they ran a few miles of the line, argued, disagreed and disbanded.

Relinquishing all hopes of settling the boundary by their own efforts, both States authorized Congress in 1784 to appoint commissioners to carry into full effect the agreement of 1773. Thomas Hutchins, John Ewing and David Rittenhouse, all distinguished men of high scientific attainments, were accordingly appointed such commissioners by Congress December 2, 1785.

These three commissioners with representatives from New York and Massachusetts met at the south end of the line in July, 1787, prepared for actual field operations. The Hartford Agreement of 1773 by which they were bound, stated that the course

should be north $21^{\circ} 10' 30''$ east as the magnetic needle then pointed. There being no reliable data as to the yearly variation it was decided to adopt $3' 5''$ per year. This, for fourteen and one-sixth years, would give a variation of $43' 41''$. The actual variation was found to be $5^{\circ} 3'$ west; adding to this the variation for fourteen and one-sixth years it was computed that in May, 1773, the total variation was $5^{\circ} 46' 41''$ west, which added to the magnetic course as given $21^{\circ} 10' 30''$ east, made the direction of the boundary line at its starting point $15^{\circ} 23' 49''$ east of the true meridian. A question then arose as to whether the changes of the magnetic meridian in proceeding northerly should be taken into account in defining the boundary or whether the spirit of the agreement would not be more fully adhered to by determining the direction of the line at the starting point by the needle and continuing on that course with respect to the true meridian. "Your commissioners, in order to compromise this matter, recommend that the boundary line should be a curve which, in proceeding northward, should vary with respect to the true meridian half as fast as the magnetic meridian would do, which was unanimously agreed to by the agents in both of the two States. By observations made at the two ends of the boundary line in 1786 by Dr. Williams, it appeared that the variation at the northern extremity was $49' 30''$ more than at the southern extremity of the line. The boundary was therefore to be a regular curve proceeding at the northern extremity $21' 45''$ more westerly than at its first setting out. Your commissioners afterwards, in order to save time, trouble and expense, proposed, instead of such a curve, to run a straight line or great circle of the globe—that is, to give equal tracts of country to each State that the curve would have done. . . . The equivalent line was found to be $11' 40''$ more westerly than the curve at the place of beginning—that is, $15^{\circ} 12' 9''$ east of the true meridian, which direction we carefully ascertained by many astronomical observations and afterwards pursued the same . . . to the northern boundary of the State of Massachusetts."

The line, as thus established, was accepted by both States as the jurisdictional line and remained in force in its entirety until the cession of the Boston Corner tract was made.

In the southwest corner of Massachusetts, between the New York boundary line on the west and the high hills of the Taconic range on the east, is a triangular shaped piece of land which, owing to its ease of access from New York city and the protection which was afforded by the topography of the country when there, had been for a long time the rendezvous of a most vicious and depraved class who were desirous of evading the severity of the law; cut off from the rest of the State by almost impassable hills, a great difficulty was found by the Massachusetts officials in affording to the settlers and inhabitants of this tract sufficient police protection.

The disgraceful and notorious incidents connected with the Morrissey-Sullivan prize fight which was held here were of such a character that in 1853, by act of the Senate and House of Representatives of Massachusetts "sovereignty and jurisdiction over that portion of the Commonwealth known as the District of Boston Corner is hereby ceded to the State of New York."

The boundaries of this tract, as taken from the official map which is now on file in the office of the Secretary of State, are beginning at a heap of stones standing in the south boundary line of Massachusetts and the northwest corner of Connecticut run thence along the south bounds of Massachusetts in a direct line to the northwest corner of the oblong.

. . . . At the distance of forty chains established the southeast corner of Boston Corner thence to the eastern line of New York by the true meridian north $1^{\circ} 57' 16''$ west 207.49 thence on the old State line to the northwest corner of oblong south $15^{\circ} 12' 09''$ 207.985 thence to the place of beginning south $89^{\circ} 08' 41''$ east 101.06.

This cession, embracing about 1,000 acres, was accepted by the Legislature of the State of New York and ratified by act of Congress January 3, 1855.

In 1887, under the direction of the Hon. Elnathan Sweet, State

Engineer and Surveyor, a survey was made of the old line by Mr. O. S. Wilson. It was hoped at that time that co-operation might be had in the work with the Massachusetts officials, but as their Legislature had given them no such authority, they were compelled to decline, and the monumenting of the line was postponed until joint action could be had.

The results of this survey were valuable in showing the unsatisfactory and unstable character of the monuments, their divergence from a straight line and in offering an excellent base for any survey that might be jointly undertaken in the future by the two States. A detailed account of the work done, and the methods employed on this survey are given by Mr. Wilson in his interesting report embodied in that of the State Engineer and Surveyor for the year 1887.

No further effort was made by either State to have the line properly marked until January, 1897, when, in a communication addressed by you to the Hon. Roger Walcott, Governor of the Commonwealth of Massachusetts, you called attention to the indefiniteness of the line as then marked, and asked that co-operation be given by Massachusetts in a joint survey and in a prominent and permanent marking to the line. A favorable reply being received, a meeting was held in Boston at which were present yourself and the Topographical Survey Commission of Massachusetts, and arrangements made for proceeding as soon as possible with the field work.

A hurried reconnaissance of the line was first made by Mr. Sidney Smith, who had been appointed by the Topographical Survey Commission as its field representative, and myself, to acquaint ourselves with the character of the country and to devise means for the proper and expeditious handling of the work. On finishing the reconnaissance we jointly reported as follows:

The reports of 1887 and 1890 have been examined and portions of the line visited.

The survey of 1887 recovered some of the original transit points near the north end and near the south end of the line. Probably more of these original points may be recovered.

The following method is suggested:

Erect a signal on the 1887 line at Berlin mountain and place a straight line instrument on Alander, thus covering about forty miles of the line. Between these stations set points upon the intermediate summits and erect signals or flags thereon, thus eliminating errors of transiting.

Also, with the straight line instrument project points from Berlin Mountain north and from Alander Mountain south to cover the extremities of the boundary; with a lighter and more portable instrument clear and measure the line between the secondary stations, at the same time recovering monuments of 1787 and local monuments set since then. Such data referred to a straight line may determine the exact location of existing points in the boundary and also the location and value of points in local surveys.

A field party, consisting of fourteen men equally divided between the two States, was organized. Camp was pitched on the west slope of Alander Mountain two and a half miles southeast of the village of Copake Iron Works and preparations made to begin work, which was to be conducted according to the following memoranda of agreement:

MEMORANDA OF AGREEMENT.

Whereas, by virtue of chapter 25 of the resolves of the Legislature of the Commonwealth of Massachusetts for the year 1897 the commissioners on the topographical survey and map of Massachusetts are authorized and directed, acting with any officers or agents who may be authorized or appointed for a like purpose by the State of New York, to locate, define and mark with appropriate monuments the true line between the territory under jurisdiction of the Commonwealth of Massachusetts and that under the jurisdiction of the State of New York, and upon completion of the work to file with the secretary of the Commonwealth a properly attested map showing the location of all the monuments marking said line and to make a report of their doings hereunder to the Legislature, and

Whereas, by virtue of chapter 421 of the laws of the State of New York for the year 1887, the State Engineer and Surveyor is authorized and directed during the year 1887 and every third year thereafter to cause to be made an examination and inspection of all the monuments upon the State boundary, and if any such monuments be found injured, displaced or removed, said State Engineer and Surveyor is authorized and directed in cooperation with persons duly authorized by the adjoining State to restore and replace the same, and to cause suitable stone monuments to be set wherever such are now lacking at the points where said State boundary is intersected by the boundary of any towns or counties of the State or by any highway, and

Whereas, pursuant to this act the State Engineer and Surveyor caused to be made during the years 1887 and 1890 an inspection and examination of the monuments marking the boundary line between the State of New York and the Commonwealth of Massachusetts, and

Whereas, said inspections and examinations disclosed the facts that few of the monuments which were originally placed to mark this line are now in existence and that these few are of an unstable character and wholly unsatisfactory for the purpose intended and that none of the town or county corners or highways has ever been authoritatively marked, and

Whereas, to fully carry out the provisions of said acts a re-survey of the entire line is demanded, now therefore

It is agreed by and between the undersigned that Sidney Smith representing the Commonwealth of Massachusetts under appointment of the Massachusetts Topographical Survey and Charles H. Flanigan, representing the State of New York under appointment of the Hon. Campbell W. Adams, State Engineer and Surveyor, shall be empowered to carry out a thorough survey and to conform to all the requirements of said acts under instructions of the parties hereto, and

It is further agreed that upon the completion of the work provided for in this agreement that a full report shall be prepared giving in detail the methods used in establishing the line, the

location of the monuments and any other interesting data; such reports to be in duplicate each to be signed by both the engineers, one to be filed with the State Engineer and Surveyor at Albany, the other to be filed with the Massachusetts Topographical Survey Commission at Boston, and

It is further agreed that each State shall furnish one-half of the necessary party, equipment, supplies, etc., and that the actual expenses incurred in the duties herein referred to, including the cost of the reconnaissance and preliminary report shall be borne equally by the two States in interest, except so far as may relate to the compensation of the engineers and assistants employed, which compensation is to be arranged by each State separately and that all expenses be accounted for in verified statements submitted in duplicate and as far as practicable supplemented by receipted vouchers from parties to whom disbursements are made, and

It is further agreed that the above work in the main is to be executed in accordance with the plan and estimate proposed in the joint report of the above mentioned assistants in charge of the reconnaissance submitted June 29, 1897.

In witness whereof Campbell W. Adams, State Engineer and Surveyor of the State of New York, and Desmond Fitzgerald, chairman of the Massachusetts Topographical Survey Commission, have hereunto set their hands and caused the seals of their respective departments to be hereunto affixed this 28th day of July, 1897.

[SEAL] DESMOND FITZGERALD,
Chairman Massachusetts Topographical Survey.

[SEAL] CAMPBELL W. ADAMS,
State Engineer and Surveyor.

Before entering into an account of the methods employed in our field work we will give a short description of the instruments used.

For the long alignment we had a Buff & Berger straight line instrument. It has three leveling screws, an axis of hardened

bell metal and can be accurately centered by a motion of the base. The telescope has an aperture of two inches, magnifying power of forty diameters and cross hairs of the X design.

The instrument used for running and staking the line between the summit points set by the straight line instrument was a Buff & Berger transit theodolite. It has three leveling screws, a movable head and an 8-inch plate reading to 20". The aperture of the telescope is 1½ inches and the magnifying power 27 diameters.

An ordinary B. & B. transit was used by the party engaged in the chaining and stadia work.

In all kinds of long line work it is essential that some means of ready communication be adopted whereby messages may be transmitted between the different field parties. For this purpose the heliotropes which had been used in the New York State Survey were employed. They consist of a piece of gas pipe 18 inches long and 1½ inches in diameter having attached to the under surface a screw 4 inches with a joint to give vertical motion; on the upper surface are two small columns 2½ inches high, one placed 2 inches back of the objective, the other 4 inches in front of the eye piece. A flat ring of an inch internal diameter is mounted on each of the columns, the plane of the rings being at right angles to the telescope. Between the last column and the eye piece, a mirror three inches in diameter capable of a horizontal and vertical motion is mounted, the center of the mirror being the same distance above the telescope tube as are the centers of the rings. The mirrors itself is the heliotrope proper. In connection with the heliotrope a second mirror of 4 inches diameter is used when it is desired to flash the light in an opposite direction from the sun; this second mirror is placed on one side of the mirror of the telescope and facing it.

By using the telegraphic code it is possible to send any given message with the heliotrope. This system has been in use for many years and while simple in operation is apt to consume much time, and time is an important factor in the sending of

heliotrope messages. We arranged a code of arbitrary signals, a copy of which was furnished to each of the heliotroppers; the code contained all sentences which were necessary to be used during the progress of work. Each sentence was designated by a special number; for instance, 16 meant "Give me a point," 33 meant "All right," 97 "Finish for the day," etc. The method pursued in the sending of messages was as follows: The observer and the heliotroppers were each at their stations at an agreed on time in the morning; if the weather conditions were favorable each heliotroper flashed his light to the other; when the flash of each was seen by the other, the heliotroper at the observing station cut off his light as a signal that he was ready to send a message; if the heliotroper at the receiving station was prepared to take the message a like signal was given in return by him. The message was made by equal intervals of flashes and cut offs.

If we desired to send, say sentence No. 8, it was done by giving eight flashes each of two seconds duration with an equal interval of cut off between them; 43 was made by giving four two-second flashes, then a cut off for five seconds, after which three two-second flashes followed, completing the sentence.

This system was readily learned by all of the heliotroppers and in its application gave excellent results.

For chaining two steel tapes, each 300 feet long, graduated to feet, except the first and last foot, which were marked to tenths, were provided. These tapes had been previously tested on a standard base; No. 1 showed an elongation in its total length at 82°F. of .2 feet and No. 2 at the same temperature an elongation of .01 feet.

To eliminate any large errors that might occur in chaining stadia rods were used. The rods were graduated according to the stadia interval of the transit, which had been found by careful experiment. They were of white pine, 8 feet long 4 inches wide and $\frac{1}{2}$ inch thick. The body ground was painted white, and the sub-divisions, feet, tenths and half-tenths, black. No numerical figures appeared on the rods, as in long sights especially they are likely to cause confusion. In extra long sights, cardboard

targets held in position by elastic bands encircling the rods were employed.

FIELD WORK.

Primarily our duties were to run a line, coinciding as nearly as possible with the line of 1787, which was indicated by stone heaps and chiseled marks cut in ledges at specified places throughout its length.

From the Wilson survey we learned that the 1787 line was not a straight line and that many of the marks that had been made by the Commissioners were missing, none having been found that could be positively identified between the eight mile point and the forty-first mile point, a distance equal to two-thirds of the entire line. Plotting the Wilson line and a line connecting the ten original monuments whose location had been reported by him, it was apparent that the divergence of the old monuments from a straight line was irregular and that no one straight line could connect them all. Averaging their locations, we computed that a line run from the point on Mt. Alander to a point eight feet west of the old stone heap on Berlin mountain, of the genuineness of which two marks we were satisfied, would coincide approximately close with the location of all the old monuments as far north as Jim Smith hill. If these two points were inter-visible we would be able to control forty-four miles of the line.

The point chosen on Alander was a little to the east of the center of the old stone heap and averaged up well with the Borden monument at Boston corner, the chiseled arrows on Alander and Prospect and the stone heap on Dugway. On proceeding to Berlin mountain, and attempting to flash a foresight from the point selected there to the party on Alander, it was seen that the line of sight was cut off by Rhodes Pinnacle and Mt. Misery. This necessitated a change in the general plan we had formed of setting most of the main points from Alander Mt. with Berlin Mt. as a foresight.

Mr. Wilson had reported the location of a stone heap on Mt. Misery which he considered to be a mark of the 1787 line, and that Mt. Misery and Alander Mt., distant apart $38\frac{1}{2}$ miles, were

intervisable. An investigation showed us on Mt. Misery a stone heap four and a half feet high and three feet in diameter, which we found on inquiry among the people living in the vicinity had been regarded for years as a point on the original line. We were further convinced of this fact by the almost inaccessibility of its position and by the trouble that we had in reaching it. Our computed line would pass five feet to the east of this stone heap; opposite the stone heap and on line a post was driven on which was mounted a heliotrope to give a foresight from Alander Mt.

In the meantime a party had moved to Mt. Harvey 16 1-3 miles north of Alander Mt. prepared to receive a point on line as soon as the foresight on Mt. Misery was observed from Alander. As this point was an important one, and at a greater distance from the observing station than any other point that was to be instrumentally determined, extra care and precautions were used in setting it. The tripod of the straight line instrument on Alander was set on hubs driven firmly into the ground and the entire instrument protected from the wind and the heat of the sun by a tent. To prevent any vibration that might be caused to the instrument by the movement of the observer around it, a low platform was built for his use. In the tripod of the signal above the instrument was another platform on which stood the heliotroper.

When the summits of Mt. Misery and Mt. Harvey had been cleared and the heliotrope flash from each of them had been seen at Alander Mt. the setting of a point on line on Mt. Harvey was made as follows:

The flash on Mt. Misery serving as a foresight, the approximate position of the point on Mt. Harvey was determined. Over this point was erected a simple platform consisting of a single plank five feet long placed at right angles to the line and supported by four posts two feet high. On top of the plank rested a small piece of joist into which had been screwed a heliotrope. The heliotrope was placed alternately east and west of the approximate point and moved slowly towards it according to the signals of the observer at Alander Mt., the movements becoming

shorter as the point was approached. When the "all right" signal was given the position of the center of the heliotrope was marked on the plank and the heliotrope was moved to the opposite end of the platform ready for another setting. The average of all the points set was taken as the true point. In averaging such points it is necessary to take them by pairs, each pair consisting of an east-west point and a west-east point. The means of such pairs will usually be found to give very accordant results. Eight points were set on Mt. Harvey, the distance between the extremes being $6\frac{1}{4}$ inches. The four set by moving from west to east were within a space of $1\frac{1}{2}$ inches and the four from east to west were within a space of 2 inches. The means of the eight settings averaging 1 and 2, 3 and 4, 5 and 6, and 7 and 8 were embraced within a space of nine-sixteenths of an inch. This excellent result was due in a great measure to the relative positions of the points Mt. Misery and Mt. Harvey, the difference in angular elevation between them being but a few minutes. The two heliotrope flashes were not only in the field at the same time, but so close together that the slightest turn of the tangent screw was sufficient to move the cross hairs from one to the other. The errors of collimation were totally inappreciable for such a small difference of altitude.

After Mt. Harvey had been set, Boston Corner was established by transiting from Alander with the straight line instrument. This instrument was not intended for transit work, but on account of its great steadiness and the excellence of the telescope, it was used for this purpose in preference to the regular transit instruments when the point to be set was a mile or more from the observer. A target two feet square, divided into four triangles by lines drawn diagonally from the corners, the upper and lower triangles painted white and the side triangles black, was used instead of the heliotrope in the setting of this point. The collimation was here found to be large, the extremes of the eight settings being $13\frac{1}{2}$ inches apart, although the groups themselves were fairly compact. The mean of all the points came $13\frac{3}{4}$ inches east of the Borden monument set to mark the old southwest cor-

ner of Massachusetts. These were the only points set from Alander.

The instrument was then taken to Mt. Fray, 5 miles north of Alander Mt., and transited into line between the Harvey and the Alander signals. The point having been determined, it was used as the observing station for setting Mt. Prospect 1 mile south, the eleventh-mile point of the 1787 survey, 2 miles north, and Hillsdale, 6 miles north. The eight settings on Mt. Prospect came within a space of $2\frac{7}{8}$ inches, the four at the eleventh mile point within a space of $2\frac{1}{8}$ inches and the eight at Hillsdale within a space of $5\frac{5}{8}$ inches. The target was used at all these points.

Cunningham Hill, 4 miles north, and Perry's Peak, 8 miles north, were established from Mt. Harvey with Mt. Misery as a foresight. Both of the settings were good.

From Perry's Peak, foresighting again to Misery, Mt. Lebanon, 2 miles north, and Rounds Mountain, 10 miles north, were set. The four points on Mt. Lebanon and the four on Rounds Mt. were within a space of 2 inches.

This finished our long alignment work for the season of 1897, and while we did not reach as far north as we had at first expected, yet considering the excessive spell of unfavorable weather which we had during July and August, weather in which any long distance work was impossible, we feel satisfied with the length of line established.

During the progress of the long distance work a transit party was engaged in the running, clearing and staking of the line between summit points already established. Owing to the very irregular surface of the country, which necessitated oftentimes short backsights and long foresights, considerable pains were required to keep on line. Foresights and backsights were taken on plumb bob strings and no foresight accepted as "all right" until it had been checked at least three times.

The transit party was followed by another party doing the chaining and taking roughly the topography.

In order to expedite the progress of the work and as insuring greater accuracy than could be obtained by the ordinary horizontal measurements, our chaining was done on the slope and the vertical angles taken. The excellent results obtained in the chaining as checked by the triangulation prove this method to have been the correct one. Our allowable limit of error was 1 in 2,000, the result of the triangulation shows an average error of 1 in 5,100. In connection with our chaining and as a rough check upon it stadia readings were taken at each station; the stadia further served the purpose of giving us an approximate profile of the entire line.

The field work was carried on until November 1st, when, owing to a lack of funds, it was discontinued for the year. Briefly reviewing the season's work we find that about forty miles of the line, including the piece from the old Connecticut corner to the angle on the Alander, have been cut, cleared and staked, and that the chaining and topography is completed for a distance of thirty-two miles; the long base line of the survey from Alander to Misery has been established and the controlling points on it firmly marked. About eighty-five monuments, including stone heaps and chiseled cuts in ledges, which are supposed to have been on the old line, were located by offset distances.

In the early part of June, 1898, according to arrangements entered into between yourself and the Massachusetts Topographical Survey Commission, field parties were again organized and all their necessary preparation made for proceeding with the work. Mr. Eugene E. Peirce, assistant engineer, was appointed to succeed Mr. Sidney Smith in charge of the field work for Massachusetts. Several other changes were made, but the party as a whole remained about the same as during 1897. We reached Hancock, Massachusetts, June 1st, established headquarters, and on the following day commenced field operations in the same order that was in force during the latter part of the previous season—the New York party, ahead, running and cutting the line, and the Massachusetts party, following, chaining and taking topography.

North of Mount Misery the summit points on Rhodes Pinnacle, Berlin Mountain and Jim Smith Hill, were set with the straight line instrument. Of these points, Berlin Mountain, about five miles from Mount Misery, is the most important as well as the highest point of the line. Before Berlin could be set a platform 12 feet high was erected there, near the approximate point, as it was found that a stone pile on Rhodes Pinnacle was on line between the point on Misery and the point on Berlin Mountain, and obstructed the view. This point was set from Mount Misery by transiting from a heliotrope stationed at Mount Harvey as a backsight; the collimation of the instrument was so slight that the groups overlapped. Sixteen points were given, and while they do not show as good an agreement as we have had at other stations yet the mean of the set is considered strong.

Rhodes Pinnacle, three miles north of Mount Misery and two miles south of Berlin Mountain, was set from Berlin by a foresight on Misery. This point is a good one.

On the two summits of Jim Smith Hill, distant respectively two and one-half miles and three miles from Berlin, points were established with the instrument on Berlin by transiting from Misery. The groups on both the summits showed a fairly close agreement.

As the north end of the line and the more northerly of the Jim Smith Hill summits are not intervisible, station Pownal was set by transiting from the latter point, about 1,500 feet north of the north end of the line on a small knoll from which the end of the line can be commanded. Foresighting from Pownal to the Jim Smith Hill summit we set a point marking the intersection of our line with the southern boundary of Vermont.

When the chaining and topography of the line were finished the results of our work were plotted and examined to see how nearly we had accomplished our purpose in running a line to coincide with the line of 1787.

The old line was controlled by seventeen transit points placed on the summits, north and south, of the mountains the line crossed; fourteen of these points were marked by a "stake and

stone heaps" and three by chiseled marks cut in the rock; the location of two of these three marks relative to the line is only given approximately. Between the transit points the line was run, presumably by compass, and the mile points marked by stone heaps. The location of these mile points was given so indefinitely that we made little effort to find them, our endeavors being wholly confined to the identifying of the stone heaps at the transit points.

Stone heaps at the best are unsatisfactory points. There is about them such a lack of reliability and want of character that it required at times greater powers of intuition than we possessed to decide whether a stone heap found was made to mark the line in 1787 or that it was placed there fifty years later by some farmer in clearing up his field.

The following table shows a list of the probable transit points of the original line which we found:

Transit Points of 1787 Line Referred to Base Line of 1898 Survey.

Distance in miles.	NAME.	Offset in feet.
0.0	Boston corner first transit post marble monument	1.1 W.
2.5	Alander mountain second transit post stone heap	0.0
2.5	Alander mountain chiseled arrow	0.19 W.
5.2	Cedar mountain stone heap	0.0
6.0	Dugway mountain third transit post chiseled M	2.0 E.
6.6	Mount Prospect fourth transit post chiseled arrow	1.8 E.
7.7	Mount Fray fifth transit post chiseled Y	2.2 E.
15.2	Sixth transit post stone heap	0.0
18.8	Mount Harvey seventh transit post stone heap	0.7 W.
40.5	Mount Misery twelfth transit post stone heap	5.5 W.
41.5	Thirteenth transit post stone heap	4.0 W.
43.3	Rhodes Pinnacle fourteenth transit post stone heap	0.0
45.9	Berlin mountain fifteenth transit post stone heap	8.0 E.
48.5	Jim Smith hill sixteenth transit post stone heap	4.0 E.
49.8	Northwest corner of Massachusetts granite monument	62.2 E.

From this table it will be seen that about as many of the old points show on one side of the line as on the other, and that the general average of these points is well represented by our straight line. The only place where any large difference appears is between the sixteenth transit posts and the end of the line where, in

a distance of one and one-half miles, we have an increased divergence from our line to the east of 58.2 feet. The northwest corner of Massachusetts was marked by a granite monument set in 1896 by the joint boundary commission of Vermont and Massachusetts on the spot occupied by the old marble post placed by Borden in 1831, and is undoubtedly the site of the corner as determined in 1787. Neither is there much doubt as to the authenticity of the large stone pile marking the sixteenth transit post.

Had we been able to locate the seventeenth transit post, which on the original map is shown about midway between the sixteenth transit post and the northwest corner, we would probably have found it close to our line as its ease of setting from the preceding point renders it unlikely that any large error could have been made here. We may therefore conclude that the divergence of the old line from a straight line really occurred from the seventeenth transit post north.

To reach the southern boundary of Vermont directly from the seventeenth transit post a distance of three-quarters of a mile, the line would have to be carried down a steep slope through the woods, there being a difference in elevation between the two points of about 900 feet. We have no record of what instrument was used in running this part of the line, but it is probable that the compass was employed, and that either through local attraction or by adopting Dr. Williams's data, which gave the attraction at the north end of the line as 49' 30'' more than at the south end, the line was deflected towards the east.

It may seem strange that on the very end of the line we should find such an error as this, an error which mars the otherwise excellent work of the original surveyors; but from the meagre and tantalizing records which they have left, it is plain that the survey on the north end of the line was hurried, and that little if any time could have been taken in checking up the work.

HIGHWAY MONUMENTS.

On most of the highways crossing the line monuments were found which for years have been accepted as State line marks. We could procure no records nor get any information telling us

how, when or by whom many of them were set, but it is unlikely that any was placed during the original survey.

Taking the highways in order from the southerly end of the line and proceeding northward we commence with

Roberts road, 2 miles. This road is now abandoned. On its north side is a white marble monument 2 feet high and 7 inches square, having the letters N. Y. cut on its west face, M. S. on its east face and J. T. H. on the south face. It is 2.9 feet east of line.

Bash Bish road, 5.2 miles. This road, leading from the village of Copake Iron Works to Mount Washington, is traveled considerably. No line mark was found on the road, but several hundred feet to the south is a birch tree 2 feet in diameter having N. Y. cut on its west side; this tree has for a long time been considered as being close to the line. It is 19 feet west of our line.

Mount Washington road, 6.7 miles. This road leads from Copake Iron Works to South Egremont. On its north side is a sawed marble post 1 foot high and 6 inches square, evidently set since the 1787 survey. It is 6.03 feet west of line.

Hillsdale-South Egremont road, 9.3 miles. This road is marked by a marble monument 2.3 feet high and 11x4 inches in section. It stands on the north side of the road close to the wall and leans slightly to the west and south. It is 15 feet east of line.

Hillsdale-North Egremont road, 10.5 miles. No line marks found here. On the south side of the road is a frame dwelling formerly used as a tavern and known as the State Line House. Our line passes a little to the east of the center of this house.

Road at 11 miles. This road is but little used. No line marks found.

North Hillsdale-North Egremont road, 12.5 miles. On the south side of the road a stake was found which, according to the testimony of the owner of the property, marked the line. It is 2.5 feet east of our line.

Road at 12.6 miles. But little travel on this road. No monuments found. There is a fence on the north and on the south

side of the road which has been considered as being on the State line. It is 16.5 feet west of our line.

Green River road or Albany turnpike, 13.7 miles. On the south side of this road is a cut marble slab 2 feet high, 1 foot wide and 6 inches thick leaning to the south and west. Its north face is marked "Albany 33 M," and its south face N. Y. S. line. It is 11.3 feet west of line.

Road at 14.4 miles. Little used. No marks found.

Upper Green River-Alford road, 14.9 miles. This road is steep and rocky allowing only light travel. No marks found.

Upper Green River-West Stockbridge road, 16.3 miles. This road is now abandoned west of the line. No marks found.

Alford-Canaan road, 20.5 miles. This road is marked on its north side by a cut marble post 2 feet 6 inches high and 7 inches square. On the east face are cut the letters Mass. and on the west N. Y. This monument leans a little to the west, and is 19.2 feet east of line.

Road at 20.59 miles. This road branches from the preceding one about 500 feet east of the line. No marks found.

West Stockbridge-Canaan road, 21.0 miles. On the north side of this road stands a marble post 2 feet 2 inches high and 7 inches square, leaning to the south. The letters Mass. and N. Y. are cut on the proper faces. It is 24.4 feet east of line.

Road at 21.5 miles has on its north side a marble post 1 foot 10 inches high and 7 inches square. It is 38.3 feet east of line.

State Line Hotel road, 21.9 miles. In the hotel steps is a sawed marble post 2 feet and 5 inches high and 7 inches square, lettered on its east face Mass. and its west face N. Y. It is 50.7 feet east of line.

Railroad monument, 21.95 miles. On the south side of the right of way of the B. & A. R. R. is a marble post 1 foot 7 inches high and 6 inches by 4 inches in section. This monument was set by the railroad engineers and is 50.2 feet east of line.

Canaan-Richmond road, 22.0 miles. A marble post stands on the north side of this road. It is marked on its south face "Road Line," on its east face Mass. and on the west face N. Y. It is 49.1 feet east of line.

Richmond Furnace-Canaan Center road, 23.0 miles. No marks found.

Road at 23.2 miles. This road leading to Cunningham Hill is seldom used. No marks found.

Richmond-Canaan Center road, 24.0 miles. A marble post 3.9 feet high and 6 inches square was found on the south side of this road. The monument is marked on its south side S. L. and on its east side R. It is 0.5 feet west of line.

Road at 24.6 miles. No marks found.

Queechy Lake-Richmond road, 24.8 miles. On the north side of this road is a marble post 3 feet 8 inches high and 7 inches by 6 inches in section. It is marked the same as the preceding monument and is 4.4 feet west of line.

Mount Lebanon-West Pittsfield road, 28.3 miles. A large stone slab was found lying on the ground on the north side of the road. On the face of this slab was carved 1818 N. York & Mass. Line 26 M. from Alby. The bottom of the stone is 1.6 feet west of line.

Old Lebanon Springs-Pittsfield road, 31 miles. This road is now but little traveled. No marks found.

Lebanon Springs-Pittsfield road, 31.3 miles. On the south side of this road was found a cut marble stone 2 feet 3 inches high and 8 inches by 4 inches in section, lettered on the east face Mass. and on the west face N. Y. It is 2.2 feet west of line.

Goodrich Hollow road, 33.5 miles. A marble monument 3 feet high and sides 5 inches wide, evidently recently set, is on the south side of the road. It is marked N. Y. on the west face and Mass. on east face. It is 3.5 feet east of line.

Hancock-Stephentown road, 35.5 miles. On the north side of this road close to a stone wall is a marble slab 3 feet 9 inches high, 1 foot and 8 inches wide and $3\frac{1}{4}$ inches thick, marked on its south broad face Massachusetts and York Line. To Albany, 25 miles. To Northampton, 48 miles. It is 12.9 feet east of line.

South Berlin road, 42.6 miles. This road is seldom traveled. No marks were found.

McKay Hollow road, 44.4 miles. This road crosses the line in three places. No marks found.

Beebe Hollow road, 45.9 miles. This road is very steep and seldom used. No marks found.

Berlin-Williamstown road, 47.3 miles. On the north side of the road standing loosely is a flat field stone marked XXII. It is 29 feet west of line.

South Williamstown-Petersburg road, 48.6 miles. Road used but little. South of road is an old fence bottom extending about parallel with the line for 500 feet. It is 6.5 feet west of line.

Williamstown-Petersburg road, 48.7 miles. This is the main traveled road over the mountains. No marks found.

Reviewing the location of the highway monuments we find that the alignment of all of them is fairly good with the exception of the monument at the "State Line Hotel," and the two to the north of it and the three to the south. Diligent inquiry made failed to tell us when or how these monuments were located, but from the almost regular divergence they show from our line—increasing from 24.9 feet at the twenty-first mile to 50.1 feet at the twenty-second mile—it is probable that their positions were all determined from the same starting point. If a line is extended from the monument on the B. & A. R. R. through the monument in front of the hotel it will pass through the parlor on the easterly side of the building, rendering the parlor a very convenient place for Massachusetts couples who are desirous of being married to become so, without wasting any time or indulging in the formality of a marriage license. On the westerly end of the hotel, safely removed from the stringent liquor laws of Massachusetts, is the bar-room. The excellent arrangement and location of the hotel relative to line, as now marked, is striking, so much so that we are led to think that the line here was made to fit the hotel and not the hotel to fit the line. Our line will place almost the entire hotel and its occupants in and under the jurisdiction of Massachusetts. A forced change of this nature is always to be regretted, but fortunately this is the only place on the entire line where residential property is thus affected.

TOWN AND COUNTY CORNERS.

There are seven towns and one county in Massachusetts and ten towns and three counties in New York bordering upon the State line. The corners of the Massachusetts towns are all marked by substantial monuments, making it a comparatively easy task to follow out the town lines whenever necessary. On the New York side of the line a careful search showed but three towns having the intersection of their boundary line with the State line marked.

In looking for corners it is unusually possible to get some kind of information from the people living near the supposed vicinity of the corner as to its approximate location. It is true that this information is generally useless, and oftentimes misleading, but it gives one at least something to work on. In the present case we couldn't even procure this information, poor though it might be, as the residents knew so little about their town corners that they wouldn't even hazard a guess as to their location. A search in the offices of the county clerks of Rensselaer and Columbia showed such a lack of information relative to their town corners that we believe those corners have never been actually marked on the ground.

In a letter addressed to you a year ago I called attention to the uncertainty attendant on the location of these town corners and urged that the supervisors of the adjoining towns be compelled, either by a survey or by an agreement between themselves, to indicate where their joint town lines intersected the State line, and that these intersections could then be marked at a minimum expense by the field party which was to monument other points on the line. In reply to a communication of yours to this effect sent to the supervisors of the towns in question, no satisfactory results have up to the present been obtained.

The power and authority to have town and county corners marked is vested by statute in the State Engineer and Surveyor, and I would again urge that this power and authority be used to the end that on the State line, at least, "a stake and stones" and "a blazed tree," which if at any time really existed have

long since disappeared, be superseded by something more permanent and more worthy of the purpose it is intended to fulfill.

The location of the town corners and the monuments marking them found, is as follows, beginning with:

North East, Dutchess county, N. Y., 0 miles. This town comprises in part a portion of the oblong or equivalent tract ceded by Connecticut to New York in 1731. Its northeast corner touching our line is the northwest corner of Connecticut, as located by the New York Commission in 1861. It is marked by a sawed marble post 3 feet 6 inches high and 8 inches square, standing on a low ridge between two high hills of the Taconic range, about 500 feet east of the Ryan Bush road. It is marked Ms. on the north face, N. Y. on west face and Ct. on east face.

Ancram-Copake, Columbia county, N. Y., 2 miles. A stone pile 3 feet high and 3 feet in diameter at the base marks this corner. It is in a thick growth of bushes at the top of a short slope and about 325 feet north of the monument on Roberts road. Its center is 6 inches east of line. This stone heap was placed here in 1857 when the town of Ancram was set off from the town of Copake.

Mt. Washington-Egremont, Berkshire county, Mass., 8 miles. A stone pile 4 feet high and 5 feet in diameter standing in a thick young growth at the foot of the sharp ascent leading to Mt. Fray, marks this corner. It is 6.2 feet east of line.

Copake-Hillsdale, Columbia county, 9.4 miles. This corner is marked by a marble monument 2 feet high and 6½ inches square, having inscribed on its west face Town. Mon. of Copake-Hillsdale. It stands in a cleared field 484 feet north of the highway monument on the Hillsdale-South Egremont road and is 11.8 feet east of line.

Egremont-Alford, Berkshire county, 12.5 miles. A sawed marble monument 1 foot high and 8 inches square, with 1829 cut on east side, A on the north side, NY on the west side, and E on south side, marks this corner. It is in a cleared field 450 feet south of the highway leading from North Hillsdale to North Egremont and 18.3 feet west of line.

Alfred-West Stockbridge, Berkshire county, 18.1 miles. This corner is marked by a rough marble stone 4 feet high and 6 inches square, standing on a rather steep slope in thick woods about a mile south of the summit of Mt. Harvey. On its south side is cut A, on its north side W. S., 1841, and on its west side N. Y. It is 49.2 feet west of line.

West Stockbridge-Richmond, Berkshire county, 22.1 miles. A sawed marble post marks this corner. It is 1 foot high, 7 inches by 4 inches in section, with the names of the towns cut on the respective north and south faces. It stands about 700 feet north of the B. & A. R. R. in open woods at foot of steep slope, and is 55.7 feet west of line.

Richmond-Hancock, Berkshire county, 27.4 miles. This corner is marked by a cut marble post 2.5 feet high and 7 inches by 4 inches in section. On its west side are cut the letters N Y and on the east side R. It stands in a cleared field 291 feet north of our signal on Perry's Peak, and is directly on line.

Hancock-Williamstown, Berkshire county, 42.1 miles. The monument marking this corner stands in thick young woods on gentle slope about 400 feet north of a small brook. It is of granite, 3 feet high and 6 inches square, marked on its north side W and on its south side H. It is 31.1 feet west of line.

TRIANGULATION.

As a check on the alignment and chaining of our base line it has been tied at the principal summit points to the Massachusetts system of triangulation. The field notes of the work pertaining to the alignment have been turned over to the United States Coast Survey for comparison, and we hope to have their results in time to make them a part of the present report.

The following table shows the distances by chaining and triangulation between the main points on the line:

Distance in miles.	From	To	DISTANCE IN FEET.		Difference in feet per 1000 feet.
			Chaining.	Triangulation.	
0.5	N. W. corner Connecticut	S. W. corner Massachusetts	2624	2624	0.00
2.6	S. W. corner Massachusetts	Angle on Alander	13648	13649	0.07
5.1	Angle on Alander	Mt. Fray	26982	26972	0.37
11.1	Mt. Fray	Mt. Harvey	58629	58633	0.07
8.0	Mt. Harvey	Perry's Peak	42274	42292	0.43
10.1	Perry's Peak	Round's Mt	53214	53239	0.49
3.5	Round's Mt	Mt. Misery	18755	18764	0.49
5.5	Mt. Misery	Berlin Mt	28894	28897	0.10
3.2	Berlin Mt	Jim Smith Hill	16752	16751	0.06
0.7	Jim Smith Hill	N. W. corner Massachusetts	3695	3698	0.81
50.3	N. W. corner Connecticut	N. W. corner Massachusetts	265467	265519	0.20

FINAL AGREEMENT.

CAMP BERLIN, WILLIAMSTOWN, MASS., *August 9, 1898.*

Memorandum of agreement, made this day between Campbell W. Adams, State Engineer of New York, and the Topographical Survey Commission of Massachusetts.

First. It is agreed that the line to be marked by stone monuments and otherwise as the jurisdictional line between the State of New York and the Commonwealth of Massachusetts shall be as follows:

Beginning at a point at the northwest corner of Connecticut, marked by a stone monument, thence running westerly about forty chains to a marble monument now standing at the northeast corner of the territory known as "Boston Corners," ceded by Massachusetts to New York in 1853; thence running about north $12^{\circ} 57' 16''$ west to a stone monument standing at the side of the Roberts road, so called; thence deflecting slightly to the west and running in a straight line toward a marble monument known as the "Hogeboom Monument" on Alander Mountain, till it intersects the base line of the survey just completed from Alander Mountain to the southerly line of the State of Vermont; thence the line follows the base line of the aforesaid survey to the southerly line of Vermont.

Second. It is agreed that the line shall be marked by placing stone bounds at each end of said line, and at all angles in same.

Third. Stone bounds shall be placed at such prominent points along said line as shall be agreed upon by the engineers of the parties hereto.

Fourth. Stone bounds or other marks shall be placed at the end of each mile measuring from the point of beginning.

Fifth. Stone bounds shall be placed at the intersection of said boundary line with all roads and railroads.

It is further agreed that the stone bounds which have been prepared by the State of New York for marking the line shall be used for marking the mile points so far as practicable. At such summits and mile points where it is not practicable to place stone bounds, a cast-iron bound of small dimensions shall be

used, secured into the rock wherever practicable, and supported by pyramids of small stones laid in cement; the design of the iron bound to be prepared by the engineer of the Topographical Survey Commission, who shall also have charge of procuring the bounds.

At road crossings and summits, where such monuments can be taken at a reasonable expense, stone bounds, similar to those now being placed on the boundary line between Massachusetts and Rhode Island are to be used, the same to be obtained from the party now furnishing the Rhode Island bounds, if they can be obtained upon as favorable terms as those bounds.

It is further agreed that, at the Shaker village road, the old 1818 stone monument, now lying on the ground alongside of the line, shall be reset on the line in addition to a new road stone.

At the intersection of the State line with all town corners, the existing corner bounds shall be reset at such intersection, first obtaining the assent of the town authorities thereto.

None of the bounds now standing as marks of the State line to be disturbed, except in cases where a new bound is to be set, simply to replace the old one without changing its location.

Approved

C. W. ADAMS,

State Engineer and Surveyor.

DESMOND FITZGERALD,

Chairman Top. Sur. Com.

To mark the line according to the terms of this agreement required forty-four monuments of the Massachusetts-Rhode Island type, the thirty-eight New York monuments and twenty-nine iron posts.

The contract for the forty-four monuments was given to D. H. Reed, Fitzwilliam, N. H. These monuments are of a light colored New Hampshire granite nine feet long, the top and upper three feet being dressed twelve inches square. On the east face are cut the letters Mass., on the west face the letters N. Y., and on the south face 1898; the letters and figures are each six inches long

and a quarter of an inch deep. These monuments weigh about 1,700 pounds.

The thirty-eight New York monuments had been ordered in 1887 from John Beattie, Leetes Island, Conn., to mark the Wilson survey. They are of a reddish gray granite and very hard, five feet long dressed on top and one foot below, twelve inches square. On opposite faces are cut the letters N. Y. and M. When these monuments mark miles points the number of the mile (measuring from the northwest corner of Connecticut) with the letter M. beneath it is cut on the south face. These monuments weigh about 800 pounds.

The twenty-nine iron posts were furnished by the Chelmsford Foundry Co., of Boston. They are of cast iron, five feet long, circular in section, increasing in external diameter from three inches at the top to four inches just above the bottom, whence the post broadens out to a base twelve inches in length and four in width. On the top of the post is an elliptical shaped head one and three-eighth inches thick, its major axis eight and three-quarter inches long. On the east face of the head are cast the letters Mass. and on the west face N. Y., and also the number of the mile when the post marks a mile point.

The monumenting of the line was divided between the two parties; the New York party to have the setting of the monuments from the northwest corner of Connecticut to and including the corner marking the towns of West Stockbridge and Richmond, a distance of twenty-two miles. From this corner to the Vermont line, a distance of twenty-eight miles, the monuments were to be set by the Massachusetts party. After the monuments had been ordered, a delay of a month occurred before they were received at the different railroad stations to which they were to be sent; during this time our full field party was maintained. On the arrival of the monuments they were distributed to their proper places on the line and the setting of them begun. Owing to a scarcity of funds our field party was disbanded for the season, October 3d, after we had set but three monuments on our end of the line.

I am glad to say, however, that those on the north half of the

line, fifty-five in number, have all been set. A detailed description of their location is postponed until the whole line is fully monumented.

There still remains to be done the setting of the fifty-one monuments on the south end of the line. This should not be a matter of much time or expense as these monuments are now lying on the ground near the point they are to mark.

In conclusion I wish to express my thanks to Mr. Henry B. Wood, chief engineer of the Topographical Survey Commission of Massachusetts, and Mr. Eugene E. Peirce, assistant engineer, for the untiring interest they have shown in the work, and for the courteous treatment I have on all occasions received from them; to Mr. G. L. Hosmer, who did most of the long alignment, and to whom I am in a manner indebted for that part of my report; to Prof. A. D. Butterfield, who had immediate charge of the chaining and the topography during the past season, and to all the other members of the party for the willingness they always showed in carrying out their respective duties, onerous though they were at many times.

Very respectfully,

C. H. FLANIGAN.

WATER SUPPLY

FROM THE

ADIRONDACK FOREST.

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Plans were adopted by the Canal Board in 1896 for repairs and improvements at Twin Lakes and Canachagala Lake reservoirs ; but the map of these two reservoirs, though placed on file in the offices of the State and the Division Engineers, are not officially signed and certified to, nor do they show that they were adopted by a resolution of the Canal Board.....	566
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REPORT

HON. CAMPBELL W. ADAMS, *State Engineer and Surveyor*:

Dear Sir.—I have the honor to submit the following brief history in relation to the reservoirs and sources of water supply in the counties of Oneida, Herkimer, Hamilton and Lewis in the Adirondack forest.

The water supply for the New York State canals is one of the most important and difficult problems with which those who are intrusted with the construction, improvement and maintenance of the State's waterways have to contend, and great credit is due to those whose untiring efforts have secured a supply so ample and satisfactory for all ordinary seasons. Especially are the pioneers, who penetrated the Adirondack wilderness and brought into use the supply from that locality, deserving of great praise; for it certainly was no easy task in those early days, when everything for their use had to be transported through an unbroken wilderness.

The surveying, though quite a serious undertaking at that time, was doubtless considered comparatively easy in contrast to the difficulties encountered in constructing the reservoirs.

The natural soil is sand, and as the dams—in the main—are earth embankments, it required the utmost care and skill in their construction to make them secure, and we have pretty good evidence that they were well built from the fact of their remaining intact under the severe tests they have been put to for so many years, for there has been but one disastrous failure among them, and that was not so much from faulty construction as through neglect or failure to open the gates in time to prevent the water running over the top and washing away the embankment. It must be admitted, however, that although the dam was well built and withstood the pressure of the water, the plan was faulty in one respect, viz., in not providing a spillway that would take care

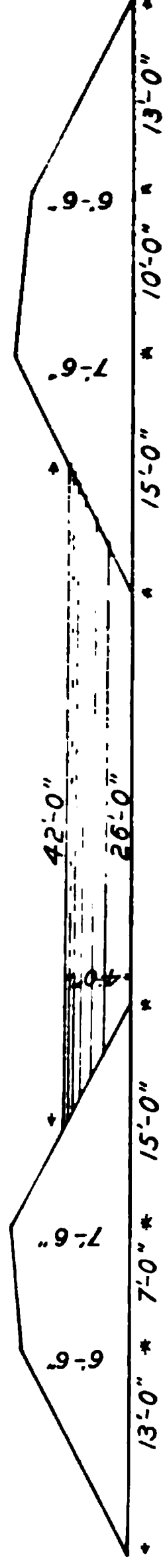
of the water at its highest stages and thereby make sure of its never reaching the top of the embankment.

When the enlargement of the Erie canal was authorized by chapter 274, Laws of 1835, it was manifest that a largely increased supply of water would be required for its use, and examinations revealed the fact that it could only be obtained in sufficient quantity from the Black river and its tributaries. To procure this additional supply of water, however, it would be necessary to provide a way for its passage from said river to the Erie at Rome.

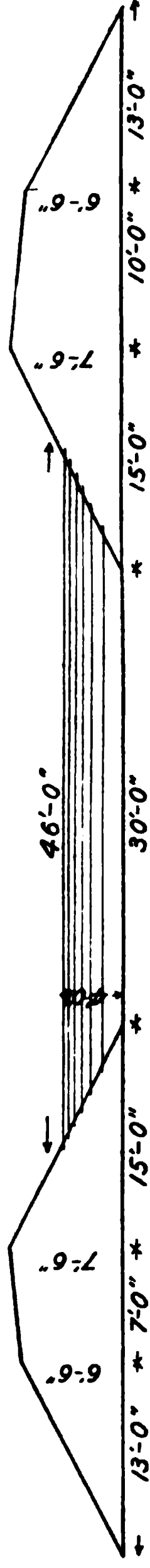
Efforts, prior to this time, had resulted in several legislative enactments which authorized surveys and estimates to be made for a proposed canal from Rome to High Falls (now Lyons Falls); and when the Act of 1835 provided for the Erie canal enlargement, those who had advocated the construction of a canal to connect the Erie canal with Black river renewed their efforts, claiming and showing conclusively that the construction of the Black River canal and feeder was a necessity for obtaining water from the Black river to supply the enlarged Erie canal, and at the same time that it would connect the Erie canal at Rome with 42½ miles of steamboat navigation on the Black river. These efforts and arguments were rewarded by the passage of chapter 157, Laws of 1836, which authorized the construction of the "Black River canal and Erie canal feeder." One of the provisions of that law was that "the feeder and canal shall be so constructed as to pass as large a quantity of water to the Erie canal as can reasonably be spared from the Black river and from the northerly portion of the Black River canal." The act also provided that payment should be made "towards the construction of said canal and feeder, such sum as the Canal Board shall estimate and certify would be the probable expense of a feeder from the Black river to the Erie canal, sufficient to supply the additional water that will be required on the Rome level, under the act for enlarging the Erie canal, passed May 11, 1835."

It was estimated that Black river would furnish 16,000 cubic feet of water per minute at low stage, and the feeder was constructed with that capacity.

SECTION OF BLACK RIVER CANAL.



SECTION OF BLACK RIVER CANAL FEEDER. DESCENT SEVEN INCHES PER MILE.



The accompanying cuts show the sizes adopted for the canal and feeder.

It was conceded from the first that uninterrupted navigation could not be maintained on the Erie canal after its enlargement without the additional supply of water from the Black river; therefore, immediate steps were taken to construct and bring into use this feeder for the Erie canal as soon as possible. Surveys were made in the fall of 1836 and spring of 1837, and the first fourteen miles of canal located and put under contract November 11, 1837. The balance of the canal to Boonville and the feeder from Boonville to Forestport (then Williamsville) were let the 24th of May, 1838. The work of construction progressed satisfactorily until the passage of the Suspension Act (commonly known as the "Stop Law") in 1842. From that time until 1847 very little was done.

Work was resumed in 1847 and the feeder, ten miles in length, or about twelve miles including the pond at the head of the feeder at Forestport, was brought into use in 1849. Water was fed through the twenty-five miles of canal from Boonville to the Erie canal at Rome in 1849, and the first boats were locked up through it from Rome in May, 1850.

This first season of feeding Black river water into the Erie canal, the summer of 1849, was a very dry one, and demonstrated the fact that the natural flow in Black river, in extremely dry seasons, would not furnish the estimated amount of from 14,000 to 16,000 cubic feet of water per minute, which, from previous examinations and measurements, was supposed to be the minimum flow of said river at Forestport.

On pages 82 and 83 of the State Engineer and Surveyor's report for 1850, Daniel C. Jenne, resident engineer, says: "In the dry season of 1849 the Black river failed to furnish the amount of water originally contemplated for the supply of the Black River and Erie canals, falling short 7,000 cubic feet per minute. The water in the river was all taken into the feeder and only furnished 3 feet in depth, which was equal to about 9,000 cubic feet per minute, and leaving the river almost dry for some

distance below, and materially affecting the water power for the whole length of the river. It became apparent that an increased supply of water must be obtained from some source, not only for the supply of the canals but to restore in part the water taken from Black river. Surveys were made in the fall of that year of Woodhull and Wolf lakes, situated about twenty miles east of the State dam, and whose outlet runs into the reservoir from which the feeder is taken. These lakes were found to contain an area of 1,163 acres favorably located for reservoirs. A temporary dam was constructed in October and November of that year across the outlet of said lakes, sufficient to raise the water 5 feet. The dam was closed the 9th of November, and about the 1st of March the water commenced running over, having raised the 5 feet in three and two-thirds months in a season of the year when there were no rains. The snow in the vicinity of the lakes was from 4 to 5 feet deep at that time, and there can be but little doubt but the water would have raised by the 1st of June from 12 to 16 feet, as the lakes receive the drainage of about 5,000 acres, had there been a dam to retain it, giving a reserved body of water of 1,400 acres (allowing for the increase of flow) by 16 feet deep, equal to 975,744,000 cubic feet, and would furnish 7,000 cubic feet per minute, for ninety-eight days, or 9,000 cubic feet per minute for seventy-five days, and 16,000 cubic feet per minute for forty-three days. This quantity would be sufficient for the purpose of making up the supply for the feeder, should a drought similar to that of 1849 again occur, and probably in ordinary years would restore to the river something near the amount diverted. If it should prove not to be sufficient there are other lakes within a few miles of the above which can be resorted to and make up the deficiency.

“I have added an estimate of the cost of building the dam and bulkhead for this reservoir of 18 feet in height, calculated to raise the water 16 feet. This estimate varies from the one reported to the Canal Board last March. That estimate was based upon a plan of raising the water 12 feet. During the past year there has been a sufficient quantity of water in the river

for the purpose of a feeder and to supply the water power below, with the exception of a few days, so that it has not been necessary to drain off the quantity reserved by the temporary dam at Woodhull lake.

“The years 1849 and 1850 are both extreme cases, the former being very dry and the latter very wet in the vicinity of Black river; therefore no comparison can be instituted between them for the purposes above mentioned. We must, therefore, take for our basis the former or season of greatest drought, to ascertain the supply required.”

In his report to the Canal Board, March 30, 1850, Mr. Jenne recommended the construction of permanent reservoirs, and said: “Unless an amount of water be restored to the Black river equal to the quantity thus diverted for the supply of the Black River and Erie canals, heavy damages to water power will ensue, the amount of which will be almost incalculable.”

Based upon this report the Legislature, April 16, 1851, passed act, chapter 181, Laws of 1851, which provided for the construction of reservoirs as follows:

Section 1. “The canal commissioners are hereby authorized and directed to cause examinations and surveys to be made of the lakes at the head of Black River, and if in their opinion necessary, also of the lakes on Moose and Beaver rivers, for the purpose of creating, if practicable, reservoirs of sufficient capacity to supply the Black River canal feeder with such quantity of water during the summer months as shall be necessary for the supply of the Black River and Erie canals, and as shall give to the Black river, as near as may be, as much water as ordinarily flows therein during the summer months.

§ 2. The said commissioners shall cause such dams, bulkheads, gates and other erections to be constructed on the streams and lakes flowing into the Black River above the canal feeder dam, or if such streams and lakes are insufficient to supply the quantity of water necessary for the purposes contemplated in the first section of this act, then the said commissioners are required to cause to be constructed such other dams, bulkheads and erections

on one or both the said Moose and Beaver rivers, as shall be necessary to accomplish the purposes in the first section specified.

§ 3. The said dams, bulkheads, gates and other erections shall be and they are hereby made part of the public works, and shall be under the control and supervision of the canal commissioners, whose duty it shall be to determine at what season of the year the said dams and gates shall be closed, and at what times and in what quantity the water from said reservoirs shall be discharged, so that the waters thus reserved shall be let into said Black river during the summer months in such manner and in such quantity as to give, so far as practicable, to the inhabitants residing on said river the benefit of said reserved waters when the same shall be required for use, and such supply shall not be less than the quantity which ordinarily flows in said river during the summer, provided the supply from said reservoirs will furnish such quantity after supplying the Black River canal and the Erie canal with water.

§ 4. The said commissioners are hereby authorized to employ such number of persons as in their judgment may be required to attend the gates on said dams, whose duty it shall be to attend said gates and to regulate the flows of water through the same, under such regulations as the canal commissioners may prescribe, subject to the approval of the canal board.

§ 5. Any person who shall wilfully open or close any dam or dams, or the bulkheads, gates or other erections connected therewith, or shall impair or destroy the same without authority from the canal commissioners shall forfeit the sum of \$1,000, to be sued for and collected in any court having jurisdiction thereof; one-half of said sum to be paid into the treasury for the benefit of the canal fund, and the other half to the person who shall prosecute for the same.

§ 6. All laws relating to the care and prosecution of the public works of this State, not inconsistent with this act, shall apply to the works hereby authorized to be erected.

§ 7. The treasurer shall pay on the warrant of the auditor of the canal department out of any moneys appropriated or to be appropriated for the completion of the Black River canal the sum of \$10,000, or so much thereof as may be necessary for the purposes of carrying into effect the provisions of this act."

Under this authority the canal commissioners in 1851 caused extensive surveys to be made for the purpose of locating reservoirs on the head waters of Black river and on the middle branch of Moose river.

The Black river, at about one mile above the feeder guard lock at Forestport, is formed by two branches, one called the Woodhull, and the other the Black River; the Woodhull has its source from Woodhull lake, located about twenty miles above Forestport. The Black River has its source from several lakes located from twenty to thirty miles above the feeder.

The surveys made at that time of Woodhull and the Black River lakes, embraced 100 miles of line explored with level and compass, entirely in an unimproved country, and cost, including the making of maps and plans, and digging of test pits, about \$3,000.

The examinations revealed the fact that a number of reservoirs could be constructed by damming up the outlets of the lakes. Maps, plans and estimates were adopted by the Canal Board for four reservoirs, viz: One on the Woodhull, one on the North Branch lake, one on the South Branch lake and another on a marsh a short distance below South Branch lake.

Their dimensions and capacities as then proposed were as follows:

	Acres.	Cubic feet capacity.
Woodhull.	1,343	1,012,452,240
North Branch	423	309,934,400
South Branch No. 1.	518	421,190,000
South Branch No. 2.	260	204,732,000
Totals.	<u>2,544</u>	<u>1,948,308,640</u>

These reservoirs were put under contract December 30, 1851.

The Engineer's estimate for same was \$44,600, and estimated cost at contract prices, \$43,635.50.

The surveys made of the lakes on Moose river in 1851, extended over sixty-nine miles of line explored with level and compass and cost about \$1,000. These lakes, eight in number, are commonly called the "Fulton chain of lakes."

It was proposed at that time to build a dam 16 feet in height at the "Old Forge dam," or 8 feet above the old dam. This would set the water back over five of the lakes. These five lakes embraced an area of 2,762 acres and their area would have been increased to 3,481 acres if the dam had been built and raised to the height proposed, and would have given an additional supply of about 1,000,000,000 cubic feet of water.

None of this water, however, from the Fulton Chain of Lakes, could reach the Erie canal, as the Moose river discharges its waters into the Black river at Lyons Falls at an elevation nearly 320 feet lower than the summit level of the Black River canal at Boonville. The object for procuring this additional quantity was to hold in reserve a supply to be used in maintaining navigation on the Black river improvement during the dry season, and to restore, in part, to the water powers between Lyons Falls and Lake Ontario, the water diverted from Black river at Forestport and sent through the feeder to Boonville and thence to the Erie canal at Rome.

The proposed plan of raising the "Old Forge Dam" was not carried into effect at that time. On page 21, annual report of the State Engineer and Surveyor for the calendar year of 1851 (transmitted to the Legislature March 4, 1852), the following statement is made: "The project for the improvement of the river, mentioned in last year's report, after making the proper explorations, was abandoned because of the limited extent of country drained by the lakes which we proposed to convert into reservoirs."

The Canal Commissioners, in their report for 1852, page 51, give as a reason for not making reservoirs of the Moose River

lakes that, "it is believed the others" (the four on headwaters of Black river) "will furnish all the water necessary, not only for the canal, but that they will also supply the deficiency in the river caused by the canal, and also do away with the annual claims for damages by mill owners on the river below High Falls."

The contracts for these reservoirs on the headwaters of Black river, as well as those for a good many other pieces of work awarded December 30, 1851, were afterwards annulled.

In his annual report for 1852, page 7, the State Engineer and Surveyor makes these statements:

"Under section 12, chapter 485, Laws of 1851, the Board of Canal Commissioners, together with the State Engineer and Surveyor and the respective division engineers on the 30th day of December, 1851, contracted for the completion of the Erie canal enlargement and the Genesee Valley and Black River canals.

"On the 2d day of January, 1852, a resolution was offered in the Canal Board disapproving of the award of some of the contracts which had been made under these laws. * * *

"On the 14th of May [1852] a circular letter was addressed to the division and resident engineers informing them that the Court of Appeals had decided chapter 485, Laws of 1851, to be unconstitutional, and that this decision precluded any further prosecution of the contracts made under that law, and directed them to measure up all the work which had been done." * * *

Hon. Wm. J. McAlpine, State Engineer and Surveyor, in his annual report for 1853, page 74, says: "Chapter 650 of the Laws of 1853, provided for the 'payment of claims upon the treasury for work done and materials delivered to the State, under the direction of the Canal Commissioners and engineers, in part execution of certain alleged contracts entered into by State officers on the part of the State in December, 1851, in pursuance of act, chapter 485, Laws of 1851.

"On the 15th of September I addressed a circular letter to each of the division and resident engineers, containing instructions in reference to rendering final accounts on the contracts above referred to."

Then, among the items for the Black River canal of "cost at relative contract prices, of work done or materials delivered under contracts let December 30, 1851," the amount for reservoirs was \$1,568.15.

The "Big Letting" of 1851 was an event long remembered and much talked of by those who participated in it.

The State Engineer and Surveyor, Hon. Hezekiah C. Seymour, in his report for that year says: "Large forces have been employed preparing for the enlargement of the Erie canal and the completion of the Genesee Valley and Black River canals, under chapter 485, Laws of 1851. Maps, plans and estimates were approved, submitted to and adopted by the Canal Board, and the work advertised for a letting.

"Proposals were received until the 18th of November, and the opening of the bids began on the 20th and occupied the Board four days. The number of propositions received were over 2,600, and each proposition generally embraced bids for a large number of sections or structures.

"The canvassing of these propositions occupied the engineering department over twelve days."

Chapter 485, Laws of 1851, which was passed July 10, 1851, and afterwards declared unconstitutional, was repealed by chapter 338, Laws of 1854.

Before reletting the reservoirs, their estimates of cost were revised and materially increased over the estimates of 1851, in consequence of a decision that the flow ground of each reservoir should be chopped and cleared, which was not included in the former estimate.

The revised estimates were as follows:

	Estimated cost.
Reservoir at Woodhull lake.....	\$18,400 00
Reservoir at North Branch lake.....	27,400 00
Reservoir No. 1 on south branch.....	17,000 00
Reservoir No. 2 on south branch.....	18,000 00
Total	<u>\$80,800 00</u>

The plans for two of these reservoirs, viz.: Woodhull and North Branch lakes, were adopted again by the Canal Board September 12, 1854. The other two, located on the south branch, were not adopted, as it was deemed advisable to make further examinations of the numerous lakes and streams connected with the Black river to ascertain if more desirable locations could be obtained than those selected in 1851.

Pursuant to chapter 329, Laws of 1854, the reservoirs at Woodhull and North Branch lakes were let by the Contracting Board at Lyons Falls, October 12, 1854.

The reservoir at Woodhull lake was awarded (on second lowest bid) to George Smith and William W. Wright, October 12, 1854.

Amount of bid was \$16,530, work to be completed October 1, 1855.

The reservoir at North Branch lake was awarded (on fourth lowest bid, three lower bids informal), to Solomon Phelps, Chester Ray and Albert Buell, October 18, 1854.

Amount of bid \$26,306—work to be completed by October 1, 1855.

March 17, 1855, the Contracting Board, by a preamble and resolution, declared abandoned the contract of Solomon Phelps, Chester Ray and Albert Buell, for the construction of North Branch reservoir, and awarded it to Walter Whittlesey, Archibald McVicker and Emery Allen, at the prices proposed by the defaulting contractors. This action was taken by request (made in writing) of Samuel Farwell and C. G. Case, sureties of former contractors, because said contractors were neglecting to prosecute the work.

Extensive examinations and surveys were made in 1855 for the location of the two remaining reservoirs, and the final conclusion was to construct one on the South Branch lake, and the other on Chub lake. These two were adopted by the Canal Board, July 11, 1855.

On the 24th of August, 1855, the Contracting Board awarded the work of constructing the reservoirs at Chub lake and South Branch lake to John Uhle.

The bid for constructing Chub Lake reservoir amounted to \$23,247.50, and that for South Branch reservoir to \$15,076.

The engineer's estimates of cost for these reservoirs, at that date, were \$26,000 and \$18,600 respectively.

The terms of the contracts required the work of constructing these reservoirs to be completed by October 15, 1856.

In planning the four reservoirs that were then under contract, it was estimated that in extreme dry seasons there would be required 16,000 cubic feet of water per minute for 110 days, making 2,534,400,000 cubic feet to keep up the necessary supply for the Black River and Erie canals. By impounding this amount and using it for the canals in the dry season, the natural flow of the Black river below the feeder dam would be left as it was before the water was diverted by the feeder.

The depths, areas and capacities of the four reservoirs as finally located and adopted were to be as follows:

	Depth in feet.	Areas in aerea.	Capacities in cubic feet.
Woodhull reservoir	18	1,236	780,943,680
North Branch reservoir.....	25	423	309,934,400
South Branch reservoir.....	24	518	421,190,000
Chub Lake reservoir.....	25	530	387,167,000
		<hr/> 2,707	<hr/> 1,899,235,080
Add second filling of North Branch.....			309,934,400
Add second filling of Chub Lake.....			387,167,000
			<hr/>
Total as then estimated.....			2,596,336,480
Quantity required for 110 days.....			2,534,400,000
			<hr/>
Excess			61,936,480
			<hr/> <hr/>

In the final location of the Woodhull reservoir, its area and capacity were materially diminished from former estimates.

"The present plan is to raise the water 14 feet, instead of 18 feet, and to draw down the water 4 feet below the original surface of the lake."

By adopting the Chub Lake reservoir instead of the South Branch No. 2, an increased capacity of about 182,000,000 cubic feet was given.

“The estimated cost of the reservoirs is increased from the estimate of last year by the difference in cost of South Branch reservoir No. 2, and the Chub Lake reservoir, and by an addition to the cost of North Branch reservoir.”

They are estimated in the report of 1855 as follows:

	Engineer's estimate.	Estimated cost at contract prices.	Amount done in 1855.
Woodhull reservoir	\$18,400 00	\$17,550 00	\$5,500 00
North Branch reservoir . . .	30,000 00	29,750 00	18,220 00
South Branch reservoir . . .	18,600 00	15,076 00	.....
Chub Lake reservoir	26,000 00	23,247 50	.....
Totals	<u>\$93,000 00</u>	<u>\$85,623 50</u>	<u>\$23,720 00</u>

December 31, 1855, the resident engineer in charge certified to the Contracting Board that the contractor for constructing Chub Lake and South Branch reservoirs had neglected to prosecute his work.

January 10, 1856, the Contracting Board declared the contracts of John Uhle, for constructing Chub Lake and South Branch reservoirs, violated and abandoned.

At a meeting of the Contracting Board, held in Albany, January 23, 1856, it was resolved to relet Chub Lake and South Branch reservoirs, and the 14th of February was named for receiving bids.

A resolution was also passed to place the bonds of John Uhle, contractor for Chub Lake and South Branch reservoirs, in the hands of the Attorney-General for prosecution.

“A meeting of the Contracting Board was advertised to be held at Lyons Falls on Thursday the 14th of February, 1856, and an attempt was made by Commissioner Whallon and the clerk to reach that place, but on arriving at Utica it was found impossible to proceed any further on account of snow.”

At Lyons Falls, March 21, 1856, the proposals for Chub Lake and South Branch reservoirs, received at that place February 14, were opened and read by Commissioner Gardinier and canvassed by the engineers.

At a meeting of the Contracting Board in Albany the 25th of March, 1856, the proposals and bonds received at Lyons Falls February 14th for Chub Lake and South Branch reservoirs were considered and a preamble and resolution adopted rejecting the lowest bids, those of William McArthur and Alfred C. Dodge, because the names of the sureties were not set opposite any amount in the justifications.

At a meeting of the Contracting Board held March 26, 1856, Canal Commissioner Gardinier offered a resolution to award Chub Lake reservoir to Walter Whittlesey, and South Branch reservoir to James Mitchell, they being the lowest legal bidders therefor in accordance with the provisions of chapter 329, Laws of 1854.

Mr. Gardinier's resolution was lost. Mr. Fitzhugh offered one which was adopted, rejecting the bids because they were "excessive and disadvantageous to the State."

The work was readvertised for proposals to be received at Lyons Falls the 22d of April.

At Lyons Falls, April 22, 1856, Commissioner Gardinier, the only member of the Contracting Board present, opened and read the proposals for constructing Chub Lake and South Branch reservoirs, and said proposals were canvassed by the engineers.

At a meeting of the Contracting Board held at the engineer's office in the village of Rome, April 23, 1856, Chub Lake and South Branch reservoirs were awarded to Surramus Britton and John V. Townsend.

The amount of bid for Chub Lake reservoir was \$27,700, and for South Branch reservoir, \$19,750. Work to be completed by April 1, 1857.

In the fall of 1856 there was a general suspension of work on the various canals of the State where improvements were in progress.

On the 16th day of October, 1856, the auditor of the canal department notified the Canal Commissioners and engineers that the amount of money provided by the Constitution and appropriated by the Legislature for the enlargement of the Erie, the Oswego, and Cayuga and Seneca canals, and the completion of the Black River and Genesee Valley canals, and the enlargement of the locks on the Champlain canal, would be insufficient for the accomplishment of these objects, and that there would be a deficiency of several millions of dollars after the amount then provided for that purpose was expended. Upon the same day that this notice was given, the Canal Board passed a resolution recommending that all works except such as were absolutely indispensable to the safe and economical navigation of the canals, should be stopped at once by the necessary orders from the proper officers.

October 31, 1856, the Canal Commissioner in charge of the Eastern Division was furnished with a list of contracts on that division that might be suspended, and said Commissioner issued the following circular letter:

“ CANAL COMMISSIONER’S OFFICE,

“ FULTONVILLE, *October 31, 1856.*

“ To , contractor for the construction of
.....for the enlargement of the Erie canal:

“ In accordance with a proviso in your contract with the State of New York, made and provided, you are hereby notified that appropriations are exhausted on the Eastern Division of the enlargement of the Erie canal for the fiscal year ending September 30, 1857.

“ No further estimates will be made from and after the 1st day of November, 1856, on account of any work you may thereafter perform or for any materials delivered until at such time as you are notified that the work embraced in your contract will be resumed.

“ (Signed)

C. GARDINIER,

“ *Canal Commissioner.*”

"The above letters were delivered to the several contractors and duplicates of each placed on file in the office of the resident engineer.

"On the 12th day of November, 1856, the work on the Woodhull, Chub Lake and South Branch reservoirs was suspended by the Canal Commissioner in the same manner and under the same circumstances and conditions as the work upon the Erie canal."

On pages 59 and 60, Canal Commissioner's report for 1856, the following statements occur:

"The North Branch reservoir was completed and the gates closed on the 1st of October, and the 1st of December the reservoir was full, although there had been no very heavy rains during that time. The branch of the river on which this reservoir is located having a very extensive drainage, it is not an uncommon occurrence to have a sufficient fall of water in the summer season to fill the reservoir in from six to ten days."

"This is also the case with the Chub Lake reservoir, and, with proper care, they can safely be relied upon for the second filling."

"The Woodhull reservoir, excepting the clearing of the flow ground, is so far advanced that a trifling expenditure would bring it into use and make it available for the coming season by omitting a portion of the clearing. The expense to make it available is so small compared with the benefits which will result from it that it is recommended that the necessary work, which consists of about 200 cubic yards of rock excavation in channel, to draw the lake four feet below the present surface and putting in the valve gates and fixtures, which are delivered at the work, be done immediately, so that the water from the spring flood may be saved. There is now available at this reservoir about 200,000,000 cubic feet of water, only a portion of which can be used, unless the channel for drawing the lake is excavated.

"If this reservoir is brought into use this season there will be available as follows:

	Cubic feet.
North Branch reservoir.....	309,934,400
North Branch reservoir, second filling.....	309,934,400
Woodhull reservoir	780,943,680
Total.....	1,400,812,480

Furnishing a supply of 8,843 cubic feet per minute for 110 days.”

In the annual report of the State Engineer and Surveyor for 1856 the estimated cost at contract prices, amount done in 1856, whole amount of work done and amount remaining to be done on the reservoirs let in pursuance of act, chapter 329, Laws of 1854, are given as follows:

CHARACTER OF WORK.	Estimated cost at contract prices.	Amount of work done in 1856.	Total amount done.	Amount remaining to be done.
Chub Lake reservoir, abandoned.....	\$60 00	.....	\$60 00	.....
South Branch reservoir, abandoned ...	185 70	.....	185 70	.....
North Branch reservoir.	83,800 00	\$15,000 00	83,220 00	\$580 00
Woodhull reservoir	17,550 00	4,030 00	9,530 00	8,020 00
Chub Lake reservoir	27,700 00	7,490 00	7,490 00	20,210 00
South Branch reservoir	19,750 00	7,490 00	7,490 00	12,260 00
Totals	\$99,045 70	\$34,010 00	\$57,975 70	\$41,070 00

North Branch reservoir was brought into use in 1857.	
	Cubic feet.
Its capacity is.....	309,934,400
Second filling	309,934,400
Total claimed for it per year.....	619,868,800

Furnishing 3,913 cubic feet per minute for 110 days.

On the 3d day of September, 1857, the Canal Board passed the following resolution:

“ Resolved, That final estimates be prepared of all the work done and materials furnished for the construction of the South Branch, Chub Lake and Woodhull reservoirs in order that the said contracts may be settled and canceled.”

The necessary measurements and estimates called for by the foregoing resolution were prepared and submitted for a settlement of the contracts in December, 1857.

It is stated in the annual report of the State Engineer and Surveyor for 1857 that the amount expended under act, chapter 329, Laws of 1854, in constructing North Branch reservoir, was \$34,636.92, and the total amount paid up to the close of 1857, towards the construction of Woodhull reservoir, under said act, was \$13,870.

Previous to 1857 no impounded water contributed to the natural flow of Black river except what little was stored at Woodhull by the low, temporary dam built there in the fall of 1849. And during each dry season since the waters of Black river were first diverted to the use of the canals, from and including the year of 1849, the mills between Forestport and Lyons Falls were crippled or at a standstill for the want of sufficient water to run them.

The owners of water powers presented bills for the losses they sustained while their mills were idle, and quite a number of claims were paid by the Canal Commissioners, who were of the opinion that the appropriation of the water diverted was only temporary, inasmuch as the reservoirs that were being constructed would, when completed, restore to Black river an amount equal to the quantity diverted.

The Canal Commissioners refer to chapter 287, Laws of 1836, under which they were authorized to settle for temporary damages.

In 1854 the auditor of the Canal Department refused to pay a draft drawn by the Commissioner for the payment of one of these claims, for the reason that he considered the appropriation of the water permanent, and that the Canal Commissioner had no authority to settle such claims.

The holder of the draft procured a mandamus against the auditor for its payment.

The auditor appealed to the Supreme Court and from that the case was carried to the Court of Appeals. The latter sustained the auditor in his decision.

This decision made it necessary for the claims to be presented for a hearing before the canal appraisers, and the question arising as to whether the claimants were not barred from filing their claims by the Statute of Limitation, the Legislature came to their relief by the passage of the following special act:

(Chapter 245, Laws of 1857.)

“An act respecting the appropriation of the waters of the Black river for the use of the Black River canal and Erie canal feeder.”

PASSED April 3, 1857.

“Within one year from the passage of this act, it shall be lawful for the owners and lessees of land and water rights upon the Black river, to present their claims for damages on account of the taking of the waters of said river for the use of the ‘Black River canal and Erie canal feeder’ the same as if they had been presented within the time prescribed by law.”

Under this act upwards of sixty claims were filed for permanent damages, aggregating over \$600,000, and extending from Forestport to the mouth of the Black river.

The hearing of the claims commenced in July, 1858, and was not completed until December of that year.

The following act authorized remuneration to persons directed by the Senate and Assembly to collect facts in regard to the diversion of the waters of Black river.

Chapter 570, Laws of 1857, entitled “An act to pay certain persons for services rendered for the state.”

Passed, notwithstanding the objections of the Governor, April 15, 1857, by a two-thirds vote.

Whereas, Certain persons—among whom were Calvin Littlefield, Hezekiah Baker and Wesley Gleason—were directed by the Senate and Assembly of this State, for the year 1855, to perform certain services for the State during their legislative terms of office, and also after their legislative terms of office had expired; and,

Whereas, They did actually render such service and the same was accepted by the State; and,

Whereas, Doubts are entertained whether, under the Constitution of this State, the services rendered by them during their legislative terms can be compensated;

Therefore, for the services hereinafter mentioned, which were rendered by the persons before mentioned, respectively, after their legislative terms had expired, and for expenses necessarily incurred in executing such services;

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

“There shall be paid to the persons severally, hereinafter named, the sums stated as follows, viz.:

“ * * * To Calvin Littlefield, Hezekiah Baker and Wesley Gleason, for services rendered this State during the months of January and February, 1856, and for expenses necessarily attendant upon the execution of said services, in collecting facts and statistics in regard to the diversion of the waters of Black river, by the State authorities, for the use of the Black River and Erie canals, and the liability of the State to pay the water owners along said river the damages sustained by such diversion, and making a report thereon to the Legislature of 1856, each the sum of \$500.”

Chapter 344, Laws of 1861 (bound with Laws of 1862) revived act, chapter 245, Laws of 1857, for presenting claims for damages for Black river water diverted to the use of the “Black River canal and Erie canal feeder,” so far as the same related to the heirs of Edmund Kirby, John Bradley, Charles E. Clark, Merrill Coburn, Peter S. Howk, John O. Dougherty, J. C. Lepper, Moulton and Symonds, Edmund Rawson, William Wilson, the heirs of Maria Babcock, William V. Morgan and the heirs of Adriel Ely.

Chapter 799, Laws of 1868, revived act, chapter 245, Laws of 1857, so far as the same applied to the claims for damages of George Smith and the heirs of William Smith, on account of the taking of the waters of the Black river for the use of the Black River canal and the Erie canal feeder.

No work was done on the reservoirs in 1858 except ordinary repairs.

The sums paid the contractors that year were the amounts due them in the settlement of the contracts that were cancelled by the Canal Board the previous year.

Division Engineer J. P. Goodsell in his annual report for 1858, says:

“I deem it of great importance that the two reservoirs, South Branch and Chub Lake, be completed as soon as any funds are provided which shall be applicable to this canal. There has been already expended on these two structures \$17,106.12, and it is estimated that to complete them, without chopping and clearing the flow ground, will cost \$39,700.”

“The Woodhull reservoir, the largest one of the group, should be finished at once. It is estimated that the entire cost to bring this important reservoir into use, exclusive of chopping and clearing the flow ground, is \$1,200.”

The amounts paid on reservoir contracts in 1858 were:

For South Branch reservoir, abandoned.....	\$1,347 16
For Chub Lake reservoir, abandoned.....	1,767 96
	<hr/>
Total	\$3,115 12
	<hr/> <hr/>

Chapters 350 and 351, Laws of 1858, were passed for the relief of Alonzo Brinkerhoff and George W. Manchester, contractors for the construction of the Woodhull reservoir; and for the relief of Surrans Britton and John V. Townsend, contractors for the construction of Chub Lake reservoir; both of which reservoirs were being constructed for the purpose of impounding a supply of water for the “Black River canal and Erie canal feeder.”

These acts directed the Canal Board to hear and determine the claims of said contractors, and award to them such sums of money as they should be equitably entitled to (without including prospective profits), for the damages sustained by said contractors in consequence of the suspension of their work on the 12th

day of November, 1856, and abandonment of their work by resolution of the Canal Board on the 3d day of September, 1857, and for change of plan in constructing the Woodhull reservoir.

Chapter 185, Laws of 1858, attached North Branch and Woodhull reservoirs and the pond at the head of the feeder to Section No. 2 of the Black River canal.

Chapter 474, Laws of 1859 (passed April 18, 1859), authorized a road laid out and constructed from the State pond at the head of the Black River canal feeder, in the town of Remsen, Oneida county, to Transparent or Jocks lake in Township No. 6, Moose River tract, in Herkimer county.

This road led directly to and past North Branch and South Branch reservoirs.

Chapter 307, Laws of 1862 (passed April 17, 1862), authorized the commissioners of the Black River State road, appointed by act, chapter 474, Laws of 1859, to levy the taxes for constructing said road.

Chapter 164, Laws of 1866, extended the time for building the Black River State road to four years from April 18, 1866.

Chapter 233, Laws of 1864 (passed April 19, 1864), entitled "An act for appropriating moneys for the improvement of Beaver river," appropriated \$10,000 for said improvement—" \$5,000 during the year of 1864 and \$5,000 in the year of 1865, for the clearing and improving the rafting channel of Beaver river, by the construction of piers, booms and dams, and removing obstructions for the passage of logs and timber over and through the Beaver river."

Said \$10,000 to be expended under the direction of John W. Wright, Charles W. Smith and Nelson Rulison, commissioners appointed by the act, who were required to file bonds in the office of the Comptroller for the faithful discharge of their duties, and to report their proceedings on or before the last day of December in each year—each of said commissioners to receive \$2 per day for every day actually employed, but not to be allowed over fifty days' fees each in any one year.

The Canal Board was directed and required to levy and collect the same tolls upon the river so improved as were levied and collected upon the several canals of this State, upon all property and boats passing up and down the same:

Chapter 816, Laws of 1866, extended the time from 1865 to December 31, 1866, for expending the money appropriated by chapter 233, Laws of 1864, for the improvement of Beaver river.

Chapter 326, Laws of 1859, appropriated \$49,780 "to the completion of so many of the Black river reservoirs as will, with the least expense, restore to the Black river 11,000 cubic feet of water per minute, being the quantity diverted to the Erie canal."

Proposals were received at Boonville on the 19th of May, 1859, for constructing and completing South Branch and Woodhull reservoirs, and on the 24th of that month the contracting board awarded the contracts to the following persons, they being the lowest legal bidders therefor, in accordance with chapter 329, Laws of 1854, viz: South Branch reservoir to Edward H. Edwards, Woodhull reservoir to William McArthur.

Woodhull reservoir was so nearly completed in 1859 as to be ready for use the following year. The cost of its completion, under chapter 326, Laws of 1859, was \$10,818.44.

The Woodhull, in addition to the North Branch reservoir already in use, furnished a supply in 1860, as follows:

	Cubic feet.
North Branch reservoir	309,934,400
North Branch reservoir, second filling.....	309,934,400
Woodhull reservoir	780,943,680
	<hr/>
	1,400,812,480
	<hr/>

Affording 8,843 cubic feet per minute for 110 days.

South Branch reservoir, completed in 1860, at a cost of \$11,196.27 paid from amount appropriated by chapter 326, Laws of 1859, was brought into use in 1861. This, with those in use in 1860, gave, according to the annual reports, a supply in 1861 as follows:

	Depth in feet.	Area in acres.	Capacity in cubic feet.
North Branch reservoir	25	423	310,000,000
Woodhull reservoir	18	1,236	780,940,000
South Branch reservoir	24	518	421,190,000
	....	2,177	1,512,130,000
North Branch reservoir, second filling . . . . .	....	....	310,000,000
Total. . . . .	....	....	1,822,130,000

As this amount furnished 11,000 cubic feet of water per minute for 115 days, it was considered by the canal commissioners and engineers in charge of the works, to fully comply with the law of 1859, which directed the completion of so many of the reservoirs as would furnish that amount per minute; therefore no effort was made at that time to complete and bring into use Chub Lake reservoir, upon which \$9,317.96 had been expended and which was one of the principal ones of the four that had been adopted, and for the completion of which chapter 326, Laws of 1859, had amply provided.

The canal commissioner, Hon. Charles H. Sherrill, in his report for 1859, after quoting the provisions of the law, says:

“To carry out the provisions of the law, the contracting board immediately authorized the construction of the South Branch, and the completion of the Woodhull reservoirs.

“It was not probably intended by the law, that the quantity of water shall be supplied during the whole year, but only during the dry, or low water part of the season, when the water diverted to the Erie canal through Black river feeders could materially affect the constant volume of water in the river to any appreciable or disastrous extent.

“The reservoirs intended to supply the quantity of water diverted are the North Branch, Woodhull and South Branch. They are located on the head waters and tributaries of the Black river, and are intended to hold in reserve the surplus waters of

the spring and fall freshets to be discharged into the river during low water in midsummer."

Then, giving the areas and capacities of the three reservoirs, aggregating 2,177 acres and 1,822,002,480 cubic feet, he continues:

"This affords a supply of 11,000 cubic feet per minute for 115 days, which is probably a full average of what is generally known as the dry portion of the year.

"The North Branch and Woodhull reservoirs are completed. The South Branch will be ready for use the coming season, and it is confidently believed, when they are all in use, the requirements of the law will be fully complied with, so far as the liabilities of the State are involved."

Division Engineer J. P. Goodsell, in his report for 1859, gives the capacities of these three reservoirs, stating that they will supply 11,000 cubic feet per minute, and then says:

"There seems to be no necessity for the completion of the Chub Lake reservoir at present."

Hon. Van R. Richmond in his annual report for 1861, says:

"North Branch, Woodhull and South Branch reservoirs are all completed. The contracts for the construction of the South Branch, Woodhull and Chub Lake reservoirs were suspended by the canal commissioner in charge on the 12th day of November, 1856, the appropriation for the same having been exhausted. Subsequently by a resolution of the Canal Board, on the 3d day of September, 1857, final estimates were prepared on those contracts suspended, that the contracts might be cancelled and settled.

"Section 1, act chapter 326, Laws of 1859, authorized and directed the construction of so many of the four reservoirs originally contemplated as would restore to the Black river, during the dry time, 11,000 cubic feet of water per minute, this being the quantity diverted from said river to the Erie canal.

"The three reservoirs which are completed will furnish 11,000 cubic feet of water per minute for 115 days."

Canal Commissioner Hon. William J. Skinner, in his report for 1861, says:

"The reservoirs on the headwaters of the Black river are in fine condition and have furnished a bountiful supply of water to the Black River and Erie canals the whole season, except during the time required to repair the break on section No. 2 of the Black River canal.

"Woodhull Lake reservoir has 17 feet of water and will not be drawn down this year. South Branch reservoir is full and will not be drawn down to any extent. North Branch reservoir has supplied most of the water required during the season and will be filled again at the opening of navigation in the spring."

Division Engineer William B. Taylor, in his report to the Canal Commissioner in 1861, says:

"The three reservoirs, North Branch, Woodhull and South Branch, are completed and in use. * * * They are capable of supplying 11,000 cubic feet of water per minute for 115 days consecutively."

I am quoting at considerable length from the annual reports for the years 1859 and 1861 for the reason that they seem to afford an answer to the question of why Chub Lake reservoir was not completed and brought into use under chapter 326, Laws of 1859.

North Branch reservoir was already completed and in use, and this law appropriated a sum sufficient to complete the other three reservoirs upon which work had been stopped for want of funds in 1856. And up to the time of the passage of this act, in 1859, every official connected with the work who expressed an opinion upon the subject had advocated the completion of the four reservoirs, believing, as they stated, that the four were needed to supply an amount of water equal to the quantity diverted from Black river for canal purposes.

But in reading over the reports of 1859, 1860 and 1861 it is quite natural to infer that when the State officials were preparing to relet these reservoirs in 1859 they saw, when computing their capacities, that three of them, viz., North Branch, South Branch

and Woodhull, would furnish 11,000 cubic feet of water per minute for 115 days, and as this complied fully with the law, according to their interpretation of it, and believing then, undoubtedly, that the quantity these three reservoirs would furnish would be sufficient to supply all demands, they quite naturally came to the conclusion that Chub Lake reservoir was not needed; therefore they did not relet it. And as the water supply was said to be bountiful the first year that these three reservoirs were all in use, the State officials were seemingly justified in their action and decision of saving to the State the sum it would have cost to complete Chub Lake reservoir.

But there must have been more than an average amount of rain in 1861, for the Canal Commissioner says South Branch reservoir was full and Woodhull nearly full at the close of navigation that year.

The following year (1862), the Canal Commissioner says:

“The reservoirs at the headwaters of the Black river have, this season, furnished material aid to navigation. They are three in number, the North and South Branch and the Woodhull reservoirs. They have each furnished their full quota, and have, together, supplied all the water necessary for the use of the Black River canal and a very large quantity to the Erie canal.”

Engineer Daniel C. Jenne reports to the Canal Commissioner in 1862 that the reservoirs answered the purpose for which they were designed, but had been used to their utmost capacity that year. He recommended the completion of Chub Lake reservoir, saying it would add about one-third to the quantity held in reserve by the three reservoirs then in use.

In the State Engineer's report for 1862, Hon. William B. Taylor recommends the completion of Chub Lake reservoir, saying it would be of great service in insuring a constant supply of water to the Black River and Erie canals in a dry season, as well as furnishing an additional quantity to the Black River improvement.

Mr. Jenne, in his report to the State Engineer and Surveyor in 1862, makes the following remarks and recommendations in regard to the reservoirs:

“The reservoirs at the head of Black river have been used to their utmost capacity the past year and have been of great service in keeping up the supply of water for the Black River and Erie canals.

“I am of opinion that Chub Lake reservoir, which was adopted and partially built, should be completed, as it would give an addition to the quantity of water held in reserve of 387,167,000 cubic feet, the surface area being 530 acres and depth 25 feet. With proper management by the man in charge of the same, there would be every probability of its being filled twice during the year. This would give a quantity of water equal to 16,000 cubic feet per minute for 115 days, while the present supply is only 11,000 cubic feet for the same time, making 5,000 feet additional to the quantity now sent to the Erie canal, at Rome, a point where it is so much needed.

“It is of the greatest importance that these reservoirs should be carefully superintended by some reliable person located at the North Branch reservoir, which is central between the other two. His exclusive business should be to look after them, and, in connection with other duties, make notes from day to day of all the facts which may occur, and to render monthly reports of the same to the State Engineer and Canal Commissioner by printed forms for that purpose.

“For the accommodation of this person, a good dwelling-house should be built, with a rain gauge attached, so that an accurate fall of rain and snow from year to year shall be obtained. The Canal Commissioner, at my request, has had gauges put into the wells and bulkheads of each reservoir so that the height of water in each can be accurately taken at every visit of the person in charge.

“He should also report the days he commences drawing from each reservoir and the number of valves opened; also, from time to time, the changes in opening or closing the same.

“In this way the accurate amount of water in each reservoir, as well as the calculations of the supply constantly on hand, may be made known to the State officers in charge.

"A valuable fund of information by this means will be obtained for scientific purposes and for future reference, without any material extra expense."

Accompanying Mr. Jenne's report (between pages 28 and 29, State Engineer's report for 1862) is a neat map of the lakes and reservoirs at the headwaters of Moose and Black rivers, showing the (then) present and proposed feeders to Black River canal. Said map was reduced from map of surveys made in 1851-1854 and 1855.

A similar map, on a somewhat larger scale, accompanied the report (between pages 58 and 59) of the State Engineer for the year of 1855.

In the annual report of the State Engineer and Surveyor for 1862, the capacities of the three Black River reservoirs, completed and in use, are given as follows:

RESERVOIRS.

	Area of surface acres.	Average area acres.	Depth in feet.	Capacity in cubic feet.
Woodhull	1,236	1,118	18	876,550,000
North Branch	423	277	28	310,000,000
South Branch	518	372	26	421,190,000
Totals.....	2,177	1,767	.....	1,607,740,000

A marginal note says North Branch reservoir can be filled twice during the year.

This table of the reservoirs is repeated in each annual report from this date to and including the year of 1871.

During these years, whenever a drought occurred, it demonstrated the fact that more reservoirs were needed, and gave convincing proof to those who had thought and declared the three reservoirs then in use were sufficient to furnish all the water that would be required, that they had made a mistake in not completing and bringing Chub Lake reservoir into use when the money for that purpose was available.

They evidently based their calculations in error by assuming that North Lake reservoir could be depended upon to fill twice yearly and that Woodhull would fill every year.

The watershed at North lake is large and there is seldom a year when the melting of the snows, in addition to the spring rains upon it, do not furnish a supply of water sufficient to fill two or three such reservoirs; but this excessive amount comes at a time of the year when it is not needed and cannot all be used, and as there is not storage capacity for it, the surplus is wasted, and there must be no hesitancy in permitting, and even in helping it to run to waste, during such formidable freshets as are apt to occur in that locality.

And after these spring freshets have subsided, if there is but little or no rain during the summer and fall months, when the full natural flow of the river is in constant use and demand, there is no opportunity or material for the second filling of North lake, and as it is a well known fact that two ordinary years are required for the filling of Woodhull reservoir, it can be readily seen that in an extremely dry season these three reservoirs would furnish but little more than one-half of the amount of water that the annual reports claimed for them.

It is for the seasons of extreme drouth for which provision must be made, then in ordinary seasons there will, of course, be enough and to spare.

And instead of assuming 115 days to be the maximum for seasons of greatest drouth, it would have been better to have provided for at least 150 days, for the records show protracted dry seasons extending from May till late in November.

There have been seasons when it became necessary to lower the outlets of some of the lakes and reservoirs, not only in the North Woods, but at other localities, to procure a supply of water sufficient to maintain navigation through the late fall months.

Even in ordinary seasons, unless the water supply was judiciously managed by men of experience and excellent judgment, delays to navigation would frequently occur for want of a sufficient depth of water to float loaded boats. And in extreme dry seasons, boats would sometimes be aground for days at a time, especially on the summit levels.

Therefore, notwithstanding that in 1861, the first year that North Branch, South Branch and Woodhull reservoirs were all in use, the State officials had expressed their belief that these three reservoirs would furnish all the water needed for the Black River canal, and a bountiful supply to the Erie canal at Rome, they immediately after that, and in nearly every annual report for a score or more of years, asked the Legislature to provide means for an additional supply of water.

It is quite evident that when making their calculations for the supply of water that would be needed for the canals, they had not made an allowance for the longest seasons of drouth.

Then, in computing the capacities of the reservoirs that would afford a supply of 11,000 cubic feet of water per minute in compliance with act chapter 326, Laws of 1859, they seem to have lost sight of the fact that while the 11,000 cubic feet per minute were being diverted and sent to the Erie canal, 16,000 cubic feet per minute were being drawn from the reservoirs. It was conceded by all that 16,000 cubic feet per minute should be taken into the feeder from the Black river at Forestport and be delivered to the summit level at Boonville, from whence 11,000 of it should go southward to the Erie at Rome, and the other 5,000 should supply the Black River canal north of Boonville; and because this 5,000 cubic feet per minute was restored to the Black river at Lyons Falls, it was left out of the calculation. But the reservoirs were being depleted that much more every minute, consequently instead of holding out for 115 days, the 1,822,130,000 cubic feet of water in the three reservoirs would be exhausted in 79 days. And even if Chub Lake reservoir had been completed and brought into use, the supply from the four reservoirs would have lasted but 96 days.

The scarcity of water and consequent detention to navigation upon the Rome level of the Erie canal was a very serious matter, and several plans were proposed for procuring an additional supply of water sufficient to maintain uninterrupted navigation through the dry seasons.

One of the plans proposed—and finally carried into execution—was the construction of the DeRuyter reservoir, located at the head waters of Limestone creek, and on the division line separating the counties of Madison and Onondaga.

The construction of this reservoir was authorized by the Canal Board in January, 1861, and was brought into use in 1863. It has an area of 626 acres and a capacity of 500,000,000 cubic feet.

In addition to Limestone creek, the reservoir receives the flood waters of Tioughnioga river to insure a full reservoir at the opening of navigation each year.

Although this reservoir gave an additional supply of nearly 4,000 cubic feet of water per minute for 100 days, it fell far short of making up the full deficiency for the Rome level in an extremely dry season.

In the year of 1864—which was not considered an extremely dry one—the Canal Commissioner in charge of the Eastern Division, has this to say in regard to the water supply:

“The insufficient supply of water between lock No. 39 and a point nine miles west of Higginsville, has long been a source of great annoyance and delay to those navigating the canal, and the means of obtaining the necessary supply has been the topic of many discussions. On the last revival of the discussion, with a view of meeting the difficulty, it was contended that the DeRuyter reservoir, when finished, would supply all that was necessary.

“This it has failed to do, and during the last season navigation has been suspended at least 20 days in consequence, and boats have been detained a longer period because of the difficulty of passing the crowds which are universally the result of any stoppages. Had the business upon the canals been as flourishing as in some of the past seasons, the crowds would have been larger and the detentions longer.”

“There is only one practicable method, in my opinion, remaining, and that is the construction of the Fish Creek feeder. The construction of this feeder was warmly advocated in the report of the Canal Commissioners of 1860, and the matter was strongly

urged upon the Canal Board, but that body saw fit to cause the construction of the DeRuyter reservoir in place of the Fish Creek feeder, and experience has shown the DeRuyter unequal to the demand upon it."

Hon. J. P. Goodsell, State Engineer and Surveyor, in his annual report for the fiscal year ending September 30, 1867, explained the situation in regard to the water supply as follows:

"August and September taxed to the utmost every source for the supply of water, and occasionally that supply was insufficient. The season has given its testimony to the absolute need of an increased supply for the long level in order to meet the demands. * * * I cannot relieve myself from the discharge of a high public duty without endeavoring to impress upon the Legislature the serious embarrassments which grow out of this straitened supply of water, and the great necessity of its immediate public recognizance and relief. Persons engaged in the traffic of our canals for the past few years have greater fears of delays growing out of the want of water than from any other source, and the experience of the last five years fully justifies this apprehension. * * * "

I am taking the liberty to digress thus from the main subject for the purpose of showing the needs of the Rome level of the Erie canal; but, as the main object for which the reservoirs in the Adirondacks were constructed and brought into use was to supply the deficiency of water for the Rome level, it seems to me proper to explain in this connection the real wants of this long level.

The proposed Fish Creek feeder was the cause of much controversy for a number of years. The subject elicited frequent and earnest discussion—both oral and written—by the State officials; some of whom favored, while others strongly opposed the project.

But after DeRuyter reservoir had been in use long enough to prove to its advocates that the supply it furnished, although fully equal to the quantity claimed for it, was far short of affording full relief in a real dry season; those who had previously

opposed the Fish Creek feeder project changed their views, and thereafter were as earnest and energetic in their efforts for its adoption as they had heretofore been when working to defeat it.

Finally, the united efforts of the friends of the measure resulted in the passage of act chapter 877, Laws of 1869, "For the construction of Fish Creek feeder," which appropriated for the purpose "the sum of \$100,000 or so much thereof as may be necessary."

This feeder would have been eleven miles long, and was to deliver 7,500 cubic feet of water per minute to the canal at a point three miles west of Rome.

Several estimates of cost are given during the years from 1861 to 1870. Said Estimates range from \$335,000, in 1861, to \$693,250, in 1870.

October 20, 1869, the Canal Board adopted the maps, plans, estimates and specifications for the construction of Fish Creek feeder and passed a resolution to let sections Nos. 1, 2, 3 and 4 of said feeder. (The proposed feeder was divided into 6 sections.)

The board of trade and citizens of Oswego strongly opposed the construction of Fish Creek feeder, claiming the diversion of water by it would seriously interfere with the manufacturing interests of their city. In view of this the next Legislature gave the Canal Board discretionary power to procure the deficiency of water from the Rome level from other sources.

Chapter 767, Laws of 1870, reads as follows:

"The sum of \$100,000 appropriated by Chapter 877, Laws of 1869, for the construction of the Fish Creek feeder, may, in the discretion of the Canal Board, be applied to the construction of any feeder or reservoir which will supply the present deficiency of water on the long or Rome level."

Notwithstanding this authority, which relieved the Canal Board from its obligation to carry into effect the original law, the majority of the Board were still in favor of applying the appropriation towards the construction of Fish Creek feeder.

On the 6th of August, 1870, the committee (W. H. Bristol,

treasurer, and Van R. Richmond, State Engineer and Surveyor, two members of the committee) to whom was referred the memorial of the city of Oswego in relation to the construction of Fish Creek feeder, "respectfully report:" "That we see no reason for recommending any modification or change of the resolution of the Canal Board of October 20, 1869, adopting the maps, plans, estimates, and specifications for the immediate construction of Fish Creek feeder."

During the controversy over the proposed Fish Creek feeder; first, between members of the Canal Board, and afterwards, between the Canal Board and the citizens of the city of Oswego, the extremes of wet and dry seasons were experienced.

Great damage was done by the excessive rains and extraordinary freshets of 1865 and 1869, while upon the other hand the drouths in 1867 and 1871 were so severe and protracted that the reservoirs were exhausted and resort had to be made to the lowering of outlets, and the bringing into temporary use of a new feeder to procure enough water to continue navigation through the fall months.

The freshet of April 21, 1869, carried away the heavy embankment, bulkhead and culverts at North Branch reservoir. This was in consequence of the inadequacy of the spillway to take care of the flood waters, which ran over the earth embankment and washed it away.*

When the great volume of water from this break reached Forestport, it swept away the embankment for 130 feet in length and 30 feet in depth, to the rock, so that the entire river passed around the east end of the dam at that place.

The Canal Commissioner in his annual report for 1869, says:

"The repairs to North Branch have been in progress all summer, and the reservoir is being reconstructed on a somewhat different and much more substantial plan. The old chute has been abandoned, and a new natural one will be constructed at south end of reservoir."

The amount expended in 1869, repairing break at North Branch reservoir, was \$58,926.46.

In the annual report for 1870 the Canal Commissioner in charge of the Eastern Division speaks of the floods and disasters the year before as follows:

“The season of 1869 was a particularly disastrous one to the canals of this division by reason of the several unprecedented freshets which occurred in that year; that of April 21, on Black river, involving the loss of the North Branch reservoir, and inflicting great damage to the banks and structures of that canal. * * * *

“On the 4th of October, 1869, there occurred one of the most extraordinary floods ever known in eastern New York. This was followed, on the 11th, by another which widened and deepened the breaks made by the former and greatly increased the damage and cost of repairs. * * * At North Branch reservoir the heavy snow in the fall of 1869 prevented the finishing and testing of the new dam then erected, and during the past season the dam has been strengthened and loaded with several hundred tons of stone, an apron constructed below the sluices, the gate stems taken out and refitted, new slope wall made on the face of the embankment and the new chute or spillway finished and cleaned out.”

The breaking away of North Branch reservoir in 1869 left but two reservoirs—the Woodhull and South Branch—to furnish an impounded supply of water from the headwaters of the Black river and its tributary in 1869. But the natural flow from the streams, fed by the copious rains, gave an abundance of water to the canals that year.

Chapter 767, Laws of 1870, appropriated \$2,500 “for difference of cost in reconstructing the bulkhead and culverts at Woodhull reservoir, on Black River canal, over cost of present plan.”

At a meeting of the Canal Board the 2d day of July, 1870, plans, specifications and an estimate were approved and adopted for “the insertion of cast-iron discharge pipes in place of the old wooden bulkhead at Woodhull reservoir,” and a resolution was passed authorizing the work of reconstruction to be done

by the day under the direction and control of the commissioner in charge, at not to exceed the estimated cost of \$11,590.

A tablet in the masonry, near the discharge pipes at Woodhull reservoir, affords the following information:

Built in 1853.—Rebuilt in 1870.

George W. Chapman, Canal Commissioner,

E. H. Crocker, Division Engineer,

C. L. Phelps, Engineer in Charge,

Alexander Pirnie, Master Mason,

R. Sanford Miller, Superintendent.

The Canal Commissioner, in his report for 1870, explains the rebuilding of this reservoir as follows:

“The bulkhead, pipes and gates of Woodhull reservoir are being rebuilt, on a change of plan, in a very complete and permanent form. The superintendent has expended, for opening a road to the reservoir, ‘eight miles through the woods,’ and in erecting such buildings as are necessary for keeping the men engaged on the work, the sum of \$3,696.80. This reservoir has not been filled to a depth of over eight or ten feet for several years owing to the dilapidated and dangerous condition of the wooden discharge pipes and bulkhead. An appropriation of \$2,500 was made by the Legislature of 1870 to pay the difference in cost between wood and iron pipes for this reservoir, the balance of the cost of reconstruction to be paid from ordinary repairs. Two iron pipes, nearly 100 feet in length, 30 inches inside diameter, with Ludlow’s patent valves or stop-gates, have been put in by the commissioner in charge. The pipes have been laid in masonry and cement, with stone well-house, wooden head-gates, and the whole done in the most thorough and substantial manner.

“The expense of reconstruction has been large, but there can be no doubt of the duty of the State, in storing this large quantity of water, to take every possible precaution to protect its own property, and that of its citizens below, from the calamity of a

Black river flood that might exceed in its terrible consequences the great freshet of 1869."

A "map of proposed Sand Lake reservoir," from surveys made in July, 1871, accompanies the Canal Commissioner's report for that year, and August 4, 1871, the Canal Board passed the following resolution:

"Resolved, That the map, plans and estimate this day submitted for building a reservoir and accumulating water at the outlet of Sand lake, near Black river, having been examined and approved by the State Engineer and Surveyor, the same are hereby adopted, and the commissioner in charge of the Eastern Division is hereby authorized to construct the same by the day, at a cost not to exceed \$16,000, the amount of said estimate, payable from the appropriation to supply the present deficiency of water on the Rome level, as provided by chapter 767 of the Laws of 1870."

Under this authority the Canal Commissioner immediately began the work of construction, and the reservoir was completed in 1872 and brought into use in 1873.

Sand Lake reservoir is situated about $1\frac{1}{2}$ miles southwesterly from Woodhull reservoir. It is formed by flooding Mud and Sand lakes to a depth of 15 feet above the surface of Sand lake. This was done by constructing a stone masonry dam across and connecting two deep gorges in the solid rock on the outlet of Sand lake. In one of the gorges the discharge pipes were placed, while the other was used for a spillway.

The water to fill this reservoir is obtained, principally, from the First, Second and Third Bisby lakes, which lie southeasterly from the Woodhull.

The original outlet of these three Bisby lakes discharged their waters into the Fourth Bisby and thence into Woodhull creek some distance below Sand lake.

A dam was built at the original outlet of the Third Bisby lake, and a new channel 1,200 feet long, 16 feet wide and averaging $2\frac{1}{2}$ feet in depth, was excavated, and the water turned through it, so that the waters from Third Bisby would run into Sand lake.

Another channel 650 feet long, 18 feet wide and averaging 3 feet in depth was cut from Mud lake southerly to Sand lake, so that Mud lake could be drawn down when the reservoir was emptied.

Page 54, Canal Commissioner's report for 1871, furnishes the following information in regard to Sand Lake reservoir:

"Area of surface, 344.50 acres; average area, 305.81 acres; depth, 15 feet, and can be filled twice yearly; capacity, 199,879.-822 cubic feet; supply for 100 days, 1,388 cubic feet per minute."

In the year of 1871 the drought was so severe and protracted that it became necessary to resort to extreme measures to procure a sufficient supply of water to maintain navigation upon the Rome level through the fall months.

The Canal Commissioner, Hon. George W. Chapman, in charge of the eastern division, explains the situation in the following words:

"Early in the season of 1871, from the increase in business upon the canals, and the unusually low stage of the streams and lakes, danger was apprehended of a failure of a supply of water.

"It became necessary to commence drawing from the reservoirs at Black river in May, at least a month earlier than ever known before. By the first of July great difficulty was found in keeping up the Rome level, and occasional detentions of a few hours at a time began to occur.

"The supply from the feeders and reservoirs on the middle division, coming into the Rome level (which extends from Utica to Lodi, 56 miles,) being limited, proved insufficient to furnish its usual proportion of water for this level. The feeding from the Black River reservoirs was increased to its utmost capacity and continued at a rate that would exhaust all the reservoirs by the 15th of October. With this, it was found impossible to keep up uninterrupted navigation on this level.

"Chapter 196, Laws of 1833, provides that 'whenever the navigation of any of the canals shall be interrupted or endangered, by reason of a deficiency of water, it shall be the duty of the

Dam,' all of the parties owning the lands and waters to be affected have released, or are willing to release them in favor of the State.

"During the present session of the Legislature, an effort will be made asking the State to assume the responsibility of damages to parties who refuse to release, but as all of the land owners to be affected by the construction of the dam are largely interested beyond the damages to be incurred, they can well afford to release as required by the act.

"The construction of the proposed work has a two-fold object; first, to supply an increased quantity to the Black river improvement, between Lyons Falls and Carthage; and, second, to maintain uninjured the various powers on Black river from Carthage to Lake Ontario, which include the valuable and extensive mills and shops at Watertown.

"The owners of these different powers claim that in appropriating the head waters of the Black river for the construction of its several reservoirs, and the subsequent appraisement of damage incurred by the loss of water, the State did not fairly compensate them, as practice has since demonstrated. Originally, it was anticipated that the reservoirs would supply all the water necessary for the canal, without interfering in mid-summer with the natural flow of the river, and that the powers below the reservoirs, on the river, would not be essentially damaged. On this theory the appraisements and awards were adjusted.

"Experience shows that the State uses more water than was originally calculated, and hence the basis of settlement with these parties was not just.

"Legally, they have no claim for additional damages, but, under the facts demonstrated, the State is in honor bound to construct the dam in question, so as to return to them a portion of the waters of which they have been deprived, by having it diverted to assist the navigation on the Black river improvement, a State work.

"The question is simply whether the State shall assume whatever damages may arise in consequence of the Moose River dam,

where parties refuse to release, or whether it will insist that those interested, and to be benefited, shall bear their proportion. The appropriation of \$18,000, made in 1872, if not re-appropriated will expire in two years from date of act."

The expenditures at the four reservoirs from 1869 to September 30, 1873, were as follows:

North and South Branch reservoirs.....	\$54,893 59
Woodhull reservoir, roads, etc.....	39,489 67
Sand Lake reservoir.....	34,227 72
Total	<u>\$128,610 98</u>

The water furnished by the reservoirs is drawn only in the dry season, and passed down through the natural channels of Black river and Woodhull, about 20 miles each, to the pond above the dam at head of Black river feeder, known as the Forestport pond, which flows about 150 acres. From this pond the necessary quantity is taken into said feeder and flows to the summit level of the Black River canal at Boonville. From this point the canal is supplied both ways, and the balance, designed for the use of the Erie canal, is passed off by a waste-weir into the Lansing Kill, at the south end of the summit, thence into the Mohawk river, from which it enters the Erie canal by the feeder at Rome.

The water that supplies and passes through the Black River canal south from Boonville, also enters the Erie canal at Rome.

Chapter 598, Laws of 1869, entitled "An act to authorize the Canal Appraisers to hear claims of owners of property on the Black river for damages caused by the escape of the water of North Lake reservoir, in April, 1869," passed the 5th day of May that year.

Section one reads as follows:

"The Board of Canal Appraisers is hereby authorized and empowered to hear all claims for damages sustained in consequence of the break in the dam or embankment of the North Lake reservoir, so called, in Herkimer county, on or about the 21st day of April, 1869, by any person or corporation owning or occupying

any land or property between said reservoir and the mouth of Black river. The said appraisers shall first inquire and ascertain whether the break in said reservoir and escape of water therefrom, and the consequent damage, were caused by any fault or neglect on the part of the State, or any of its authorized officers or agents, under circumstances which would create legal liability if proved against an individual or corporation. The said board shall next hear the claims for damages to property on or near said Black river, or its branches, between said reservoir and the junction of Black river with Moose river, in Lewis county, and after hearing such claims shall hear claims for damages to property below said junction. And in case the said appraisers shall find that such break and escape of water, and consequent damage, was caused by the fault or neglect of the State, or its officers or agents, under the circumstances above mentioned, they shall appraise and award the damages sustained by the respective claimants, on or before the 31st day of December, 1869, the facts found by them and their appraisal. But no person or corporation shall be entitled to a hearing before said appraisers unless such claimant shall, within three months after the passage of this act, file in the office of said appraisers a verified statement of such claim, showing the nature and amount thereof, and the nature and location of the property for which damages are claimed. And said appraisers shall not appraise or award any damages under this act which shall not be clearly proven to have resulted from said break in said reservoir and the escape of waters therefrom."

The reservoirs, in connection with section No. 2 of the Black River canal, were kept in repair by contract from April 1, 1866, to January 1, 1870.

Section No. 2 comprised that portion of the canal from 1,000 feet north of lock No. 70 to 300 feet north of lock No. 109, and included Black river feeder, and North Branch, South Branch and Woodhull reservoirs.

The contract price per annum was \$7,980.

Archibald McArthur, contractor.

Chapter 751, Laws of 1870, entitled "An act for the relief of Archibald McArthur," passed May 7, 1870, directed the Canal Board to hear and determine the claim of Archibald McArthur, late contractor for repairs of superintendent's section No. 2, of the Black River canal, for the sum of \$5,000, paid by him towards repairing the damages on said section, caused by the break in the North Branch reservoir on the 21st day of April, 1869.

Chapter 767, Laws of 1870, appropriated \$100,000 for the supply of additional water on the Rome level of the Erie canal.

The 24th day of August, 1869, the Canal Board passed a resolution authorizing the attorneys for the State to employ a stenographer in the hearing of the claims for damages caused by the break at North Lake reservoir on the 21st of April, 1869.

January 13, 1870, the Canal Commissioner in charge of the Eastern Division was authorized by the Canal Board to pay Charles Rhodes, Samuel Earl and Levi H. Brown, counsel for the State, \$1,000 each for services in the matter of the Black river claims cases.

December 28, 1871, the Canal Commissioner of the Eastern Division was given authority by a resolution of the Canal Board to pay to Levi H. Brown, \$15,149.25; to Charles Rhodes, \$10,534.86; and to Samuel Earl, \$8,716.55, in full payment to that date for the balance due for their services defending the claims against the State, known as the "Black River Claims" cases, such services having extended from the summer of 1869 to the date of this resolution, and covered almost 270 cases, involving claims against the State of nearly \$700,000.

December 29, 1871, the committee to whom was referred the bill of Hudson C. Tanner, stenographer, for his services and those of his assistants, with their traveling expenses and other disbursements in reporting the evidence in the Black river claims cases in 1869, 1870 and 1871, reported in favor of paying the bill, and the Canal Board authorized the Canal Commissioner of the Eastern Division to pay at the rate of \$3.50 per page for 2,559 pages printed, amounting to \$8,956.50.

The Canal Board by a resolution adopted October 1, 1873,

authorized the Canal Commissioner in charge of the Eastern Division, to expend the further sum of \$14,000 to complete Sand Lake reservoir, and in constructing a dam across the outlet of Third Bisby Lake, and in opening, improving and completing roads and bridges leading to Woodhull, Mud Lake, Sand Lake, North Branch and South Branch reservoirs. Said sum of \$14,000 to be charged against the appropriation provided by chapter 767, Laws of 1870, to supply water for the Rome level of the Erie canal.

Chapter 399, Laws of 1874, passed May 9, 1874, reads as follows:

“The sum of \$18,000, appropriated by act chapter 850 of the Laws of 1872, for construction of a dam across Moose river at the old Brown tract forge, is hereby re-appropriated, subject to the provisions of said act, and the Canal Commissioners are hereby empowered to take and appropriate any lands not released under said act which may be required for the purpose of building said dam.”

At a meeting of the Canal Board, July 28, 1874, a resolution to adopt a map, plan and estimate for a tree dam at Forge, Moose river, was laid on the table.

September 8, 1874, the resolution was taken from the table and a motion carried to refer the matter to the State Engineer, Commissioner in charge and Attorney-General, with instructions to report to the Board the facts.

October 2, 1874, the Canal Board approved and adopted the following report and resolution:

“To the Honorable the Canal Board:

“Your committee, to whom was referred the matter of the proposed dam at ‘Forge,’ Moose river, respectfully recommend that said dam be reconstructed to the same height as the original dam, and also recommend the adoption of the following resolution:

“Resolved, That the map, plan and estimate for the construction of a ‘Tree Dam’ at ‘Forge,’ Moose river, submitted on the 28th day of July, 1874, by Charles Hilton, Division engineer (having been approved by the State Engineer and Surveyor), be

hereby approved and adopted; but it is expressly understood that said dam shall be constructed so that it shall not exceed its original height of 8 feet and that the estimate for more than 8 feet is hereby modified so as to conform to said original height. That the sum so estimated (\$12,000), or so much thereof as may be necessary, be set apart in pursuance of law authorizing said work, and that the Canal Commissioner be authorized to let the same at not less than ten days' notice."

October 20, 1874, D. P. McQueen, of Schenectady, entered into contract with the people of the State of New York to construct a tree dam on the Moose river at "Old Brown's Tract Forge."

November 16, 1875, D. P. McQueen petitioned the Canal Board to cancel his contract, dated October 20, 1874, for a tree dam on Moose river.

The petitioner stated that the Canal Commissioner in charge directed the work stopped in August, 1875, he therefore requested that he be paid for the materials furnished and labor performed in the execution of the work, and that the \$1,500 which he had deposited with the State as security for the faithful performance of the contract be returned to him.

January 27, 1876, Mr. McQueen's petition was taken from the table and referred to the committee on construction.

The following is a copy from pages 154, 155 and 274 of the proceedings of the Canal Board for the years of 1876:

"(JULY 6, 1876.)

"(TABLE No. 2).

"EASTERN DIVISION.

"Extraordinary Repair Contract.

"No. 1376. Date, October 20, 1874. Work.—Tree dam across Moose river (B. R. C.) act of Legislature, chapter 399 of 1874.

Appropriation	\$18,000 00
Engineer's estimate	12,000 00
Engineer's estimate at contract prices	5,674 50
Last estimate	553 96
Security retained	1,500 00

"This contract has been canceled.

"Contract of D. P. McQueen, Tree dam across Moose river, 'Old Brown tract,' dated October 20, 1874.

"Canceled February 3, 1876.

"The State Engineer and Surveyor, having examined the facts of this case, finds that the division and resident engineers both ordered the contractor to deliver material in excess of the quantity set forth in the exhibit-sheet at the letting, viz., 9,000 pounds of bolts and 80 barrels of cement.

"He would, therefore, recommend that the material covered by the contract be paid for at the prices named in the final account, hereto annexed, arrived at by deducting cost of labor not done, and profit on same, from the contract prices, and that the remainder of the material be accepted by the State at fair market prices, and that the expenses of transporting the material be paid the contractor.

"He therefore recommends that the following sums be allowed the contractor for material not included in the annexed final account:

9,000 pounds wrought iron, at 5c.....	\$450 00
80 barrels cement, at \$1.50.....	120 00
Freight on cement.....	40 00
Cartage on cement.....	30 00
	<hr/>
	\$640 00
	<hr/>

"And that the security held by the State be returned to the contractor, on condition that he signs a full release of all claims against the State under his said contract.

"(Signed)

J. D. VAN BUREN, JR.,

"*State Engineer and Surveyor.*"

"FINAL ACCOUNT."

To D. P. McQueen, Dr.

"For materials furnished and labor performed under his contract dated 20th day of October, 1874, to construct a tree dam

across Moose river, at 'Old Brown's Tract Forge,' 8 feet high, act chapter 399, Laws of 1874.

Quantities.	Contract price.	Items—materials delivered.	Price used.	Amount.
7,000	\$.09	Pounds wrought iron.....	\$.07	\$190 00
1,068	.07	Pounds spikes.....	.06	63 96
				<hr/> \$553 96

"Resolved, That in pursuance of the recommendation of the State Engineer and Surveyor, the final account of the contract for a 'tree dam across Moose river,' amounting to \$553.96, be approved and paid, and that the contractor be allowed \$640 in full for materials delivered, and that the security held for the faithful performance of the said contract be returned to said contractor, on condition that he sign a release of any and all claims against the State under his said contract."

Act chapter 499, Laws of 1875, directed the Canal Board to investigate, consider and report upon the disposition to be made of the lateral canals, and made it the special duty of the State Engineer and Surveyor and the Canal Commissioners to examine the lateral canals of the State and their appurtenances, to take testimony and examine maps, surveys and documents relating to the same, to ascertain whether the same should be sold, leased or abandoned; whether any should be retained as feeders, and as to what effect such sale, lease or abandonment would have upon the legal rights of individuals, and report the facts to the Canal Board.

The Canal Commissioner in charge of the Eastern Division, the Hon. Adin Thayer, made an able report upon the Black River canal, the only "lateral" upon that division.

His reasoning and arguments in favor of retaining the "Black River canal and Erie canal feeder" as a tributary and feeder to the Erie canal were so convincing that the Black River canal still remains intact, as one of the canals which the Constitution of the State of New York says shall not be sold, leased or otherwise disposed of.

To show the importance of the water supply from the Black river, the Commissioner explains the attempt to fill the Rome level of the Erie canal in 1875 without that supply, as follows:

"The Erie canal was advertised to be ready for navigation May 18, 1875. On the 14th day of that month the water was let in, at Rome, from all sources except the Black river. On the 18th, the day for opening the canal at Rome, the water was $4\frac{1}{2}$ feet in depth, instead of 7 feet, and so remained until the 21st, when orders were given to furnish water from Black river. On the 22d, at noon, the Erie was ready for navigation. Heretofore, the Erie canal and Black River canal have been opened on the same day, and it was generally supposed the Erie would be filled in the spring, when streams are high, without resort to reservoirs."

By a resolution of the Canal Board, passed January 27, 1876, the Black River canal, with its system of feeders and reservoirs, and that portion of the Erie canal between the east line of Oneida county and the east bank of the old Oneida Lake canal, were transferred from the Eastern to the Middle Division.

For the first four months of the fiscal year ending September 30, 1878, the New York State canals were under the management of three canal commissioners. During the remaining eight months they were in charge of a superintendent of public works and his three division superintendents.

The assistant superintendent upon the Middle Division, in speaking of the reservoirs and feeders, in the annual report for 1878, says: "The Black river, with its four reservoirs, North, South, Woodhull and Sand Lakes, is the main stay of the long level of the Erie."

The sum of \$704.50 was expended in 1878 repairing these reservoirs.

There was so little rain in 1879 that it became necessary to commence drawing from the Black River reservoirs May 31st, and the constant drawing from them reduced the water supply to such an extent, that late in September the Black River canal north of Boonville was temporarily closed and all of the water

from the feeder sent southward to supply the Erie canal at Rome. And, to procure an additional supply of water sufficient to maintain navigation through the fall months, the outlets of White, Chub and the Bisby lakes were lowered, and the Canachagala lake brought into temporary use by building a dam at the northeasterly end across its natural outlet, and excavating at the south end of the lake, a new channel through which the water discharged southward into North Lake reservoir.

At the close of navigation temporary dams were constructed in the outlets that had been lowered and were built to an elevation that would insure the filling of each lake to its original height. This made available the supply that the mere removal of the temporary dams would release when the additional water should be needed.

Chapter 436, Laws of 1879, entitled "An act to provide for the construction of a dam across Moose river in the county of Herkimer,"

Appropriated \$10,000 for constructing a dam at the Old Brown Tract Forge and empowered and directed the Superintendent of Public Works to build such dam, and to take and appropriate any lands, not released by the provisions of chapter 850, of the laws of 1872, and of chapter 399 of the Laws of 1874, that might be required for the purpose of building such dam and of bringing the proposed reservoir into successful use.

A new road-bridge was built across the spillway at North Lake reservoir in 1879, and considerable work done in repairing and improving roads leading to the reservoirs.

The old road between Woodhull and Sand Lake dams, which crossed several deep ravines that were spanned with corduroy bridges, was abandoned and about two miles of new road constructed along a safer and more desirable route.

The scarcity of water in 1879 prompted the State officials to renewed and earnest efforts in the matter of procuring an additional supply for the Rome level of the Erie canal.

Late in the fall of that year, a preliminary survey for a proposed reservoir at the head of Forestport pond was ordered by

Hon. Horatio Seymour, Jr., State Engineer and Surveyor, to get such information as could be obtained in about ten days.

From the hasty survey and notes then taken by the resident engineer, Mr. Denison Richmond, it was estimated that a 15-foot flow line would inclose 700 acres giving an average depth of 7 feet.

In May, 1880, Mr. Richmond made a survey of White lake in Oneida county. The flow line for the proposed White lake reservoir inclosed 332 acres.

July 1, 1880, the Canal Board passed the following resolution:

“Resolved, That pursuant to chapter 493, Laws of 1880, the map of White Lake reservoir, prepared by Marvin Porter, division engineer, and approved by the State Engineer and Surveyor, be and hereby is adopted.”

June 19, 1880, the State Engineer wrote to the division engineer of the Middle Division that the emergency was so great he had decided to send a party into the Woods, under the charge of Chanley L. Phelps, to survey the lakes north of the Erie canal which it was proposed to use for an additional water supply.

On the first day of July, 1880, the Canal Board passed the following resolution:

“Resolved, That pursuant to chapter 385, Laws of 1876, the State Engineer and Surveyor be authorized to employ, in addition to the force at present engaged, one leveler, two rodmen, two chainmen and two axemen, to be employed temporarily in the survey for an increased water supply for the Middle Division.”

Chapter 475, Laws of 1881, appropriated \$3,500 to defray the expense of the surveys, “For increasing the water supply of the Middle Division of the Erie canal.” The act enumerates the surveying to be done as follows:

“For the survey and triangulation of Canachagala lake and line to North lake, the triangulation of First, Second and Third Bisby lakes and survey of flow and line to Woodhull lake, the triangulation of Little Woodhull lake, and survey of flow and

line to North lake, the triangulation of Gull lake and survey of flow and line to Woodhull stream, the triangulation of Sixth and Seventh lakes, Brown's tract, and survey of flow and line on Black river above Forestport pond; the work to be done under the direction of the State Engineer and Surveyor and payment to be made by the Comptroller on the certificate of the State Engineer and Surveyor."

Mr. Chanley L. Phelps surveyed Canachagala and Twin lakes in 1880.

In 1881 he surveyed First, Second and Third Bisby lakes, Little Woodhull and Lily lakes, and Gull lake, in Herkimer county; also Sixth and Seventh lakes of the Fulton chain in Hamilton county.

Maps of these lakes, aggregating 2,357 acres, accompany the State Engineer's annual report for 1881.

Chapter 533, Laws of 1880, stipulates that:

"There shall be no dam hereafter erected on rivers within this State, recognized by law or use as public highways for the purpose of floating and running lumber, logs and other timber over or upon the same, without an apron of at least 15 feet in width, in middle of the current of the river, of a proper slope, for the safe passage of lumber, logs and other timber; nor shall any bridge hereafter be built over the aforesaid rivers, except in such manner as not to obstruct or prevent the free and uninterrupted passage of lumber, logs and other timber down and along the same." This law not to apply to Hudson river.

Chapters 16 and 74, Laws of 1881, amended chapter 533, Laws of 1880, by naming, besides the Hudson river, the following rivers and waters to which the law should not apply, viz.:

"The Allegany, Delaware, Moose, Beaver, Oswegatchie, Grass, Raquette and their tributaries; nor the waters in Franklin or Lewis counties."

In 1879 the sum of \$1,033.50 was expended repairing the reservoirs, and \$1,784.52 in improving the roads leading to them.

A dam was built at the foot of Second Bisby lake in 1880, and work was in progress to convert Canachagala, White, Twin and

First and Second Bisby Lakes into reservoirs. The sum of \$4,837.20 was expended on these, also \$1,344.77 in repairing reservoirs and \$320.26 repairing the roads that year.

Woodhull Lake, South Lake and Sand Lake reservoirs did not fill during the winter and spring of 1880 and the water in North, South and Sand Lakes was entirely exhausted and Woodhull had been drawn down 7 feet at the close of the fiscal year, September 30th.

Four new reservoirs were brought into use in 1881, namely: Canachagala lake, First and Second Bisby lakes, Twin lakes and White lake.

It was estimated that these would add 278,815,875 cubic feet to the supply formerly obtained from the reservoirs in the Black river group.

The sum of \$7,589.40 was expended that year in completing these four reservoirs, making, with the \$4,837.20 spent in 1880, a total of \$12,426.60 expended in their construction.

There were expended in 1881, the sums of \$3,739.50 on repairs to the reservoirs, and \$587.16 in repairing the road to North lake.

Notwithstanding that the water supply in 1881 was increased by the quantity furnished by these four new reservoirs just brought into use, there would have been serious detentions to navigation that year had not prompt measures been taken late in the season to supply the deficiency by lowering more outlets in the North woods.

In his annual report, the Superintendent of Public Works, Hon. S. B. Dutcher, said:

“Last winter two of the largest reservoirs—the Woodhull and Skaneateles—did not fill, and the rainfall in the watershed of the northern reservoirs during the summer was less than for many years past.

“The supply was exhausted before the fall rains and it was found necessary to lower the outlets of several lakes to secure sufficient water to maintain navigation.”

His assistant superintendent, William V. Van Rensselaer, explained the situation in 1881 as follows:

"The experience of the past year demonstrates the necessity for an additional supply of water for the Rome level of the Erie canal. At the close of the fiscal year the water from the Black River reservoirs is entirely exhausted, and resort is had to lowering the outlets of several of the smaller lakes and ponds on the head waters of the Black river and Woodhull creek. But for this resource navigation must have been interrupted for a number of days. The outlets of Bear and Gull lakes and Grannis pond, and the channels above dams at South, Sand, White and Twin lakes were all lowered for this purpose. This will give an additional permanent supply from the four last named reservoirs of 30,000,000 feet per annum. After the close of the fiscal year all of these sources of supply were exhausted, and but for the timely rains from the 15th to the 20th of October, the draft of boats on the Rome level must have been reduced."

It will be seen by reading the annual reports that whenever a drouth occurred, complaints were made of the inefficiency of the water supply for canal purposes, and the Legislature was asked to provide the means for constructing additional reservoirs. Seemingly the necessity for an additional supply was as great when eight reservoirs were furnishing water from the Adirondacks, as it had been when there were but three. Therefore, it was quite natural to infer that the supply was being exhausted in some other way than by its mere use for the canals, and when examining the reservoirs the latter part of May in 1882, we learned why some of them were exhausted so early in the season, for, upon reaching Sand lake, we found that reservoir nearly empty. The gatehouse had been broken into, the valves opened and water used to float logs down the stream; and we were told that each spring when the natural flow in the streams was not sufficient to float their logs, the lumbermen helped themselves to the water in the reservoirs, in violation of the protests and strict orders of State officials, and in utter disregard of the State's rights and interests in the matter. And

it was just when the State could least afford to spare the water that the lumbermen despoiled the reservoirs. When the streams were full and the prospects good for a second filling of the reservoirs, the lumbermen had enough without purloining from the State, but when the streams were low they took from the reservoirs and if there was not sufficient rain to fill them again, the State had to be to the trouble and expense of procuring the deficiency elsewhere.

The "Lumberman's Dam," an old timber dam at Chub lake, was taken possession of by the State for reservoir purposes in the fall of 1881, and was raised and put in order to be brought into use the following year. It was estimated that the flow would cover 200 acres to an average depth of 4 feet, adding nearly 35,000,000 cubic feet to the supply from reservoirs.

A bulkhead was also placed in the dam at the foot of the Third Bisby that year, making that lake available as a reservoir by impounding an estimated additional supply of 8,000,000 cubic feet of water for the canals.

Under the direction of the Superintendent of Public Works, and pursuant to chapter 436, Laws of 1879, a dam was built across Moose river at the foot of Sixth lake, and the "Forge" dam repaired, strengthened and raised 2 feet during the years of 1880 and 1881 at an expenditure of \$5,150.77.

Forge dam flows First, Second, Third and Fourth lakes of the Fulton Chain. The aggregate surface area of these four lakes is 2,723 acres.

The Sixth Lake dam flows Sixth and Seventh lakes. The survey flow line of these two inclosed 976 acres.

In 1881 Mr. C. E. Phelps made a survey for the reservoir at the head of Forestport pond. The flow-line he ran was 21 feet above the surface of the pond and inclosed 792.94 acres.

About 30 feet in length of the Third Bisby reservoir dam was carried away by the spring floods in 1882, and was repaired in May and June of that year at an expense of \$906.52. The repairs to the other northern reservoirs in 1882 cost \$2,314.91, and the repairs to roads \$204.54.

A comfortable and convenient house was built at North Lake reservoir in 1882, for the use of the keeper. This frame house took the place of the old log house which was in a dilapidated condition, unfit for occupation.

The Adirondack reservoirs in use in 1882 were as follows:

RESERVOIR.	Completed.	Brought into use.	Flow line area.	Average area.	Average depth.	Capacity.
	Year	Year.	Acres.	Acres.	Feet.	Cubic feet.
North Branch.....	1856	1857	428	277	28	837,851,360
Woodhull	1859	1860	1,236	1,118	18	876,601,440
South Branch.....	1860	1861	518	372	26	421,312,320
Sand Lake.....	1872	1873	.....	306	15	199,940,400
White Lake.....	.....	1881	382	296	5	64,468,800
Canachagala Lake.....	.....	1881	347	320	4	55,756,800
Twin Lake.....	.....	1881	213	175	8	60,981,000
First Bisby Lake.....	.....	1881	157	}	8½	40,000,000
Second Bisby Lake .....	.....	1881	205			
Third Bisby Lake.....	1881	1882	41			
Chub Lake.....	.....	1882	530	200	4	34,848,000
						2,091,763,120
Fulton Chain:						
First Lake.....	1881	1882	403	.....	.....	.....
Second Lake.....	1881	1882	175	.....	.....	.....
Third Lake.....	1881	1882	166	.....	.....	.....
Fourth Lake.....	1881	1882	1,979	.....	.....	.....
Sixth Lake.....	1881	1882	109	.....	.....	.....
Seventh Lake.....	1881	1882	867	.....	.....	.....

Act chapter 336, Laws of 1881, appropriated \$6,000 to construct reservoirs upon the Independence and Beaver rivers in Lewis county, for the purpose of restoring to Black river its natural supply of wa'er.

This act directed the Superintendent of Public Works to build the reservoirs at such places as he might deem most expedient on said rivers, and to take and appropriate any lands not released by the provisions of chapter 850 of the Laws of 1872, and of chapter 399, Laws of 1874, which might be required for the purpose of building the reservoirs and bringing them into use.

Chapter 362, Laws of 1882, appropriated \$6,000 in addition to the \$6,000 appropriated by act chapter 336, Laws of 1881.

Chapter 491, Laws of 1883, re-appropriated the \$6,000 appropriated by chapter 336, Laws of 1881.

Chapter 551, Laws of 1884, appropriated \$6,000 in addition to the \$12,000 which had been appropriated by previous acts.

Upon examining Independence and Beaver rivers for suitable places to build the reservoirs provided for by these acts, it was decided to build but one reservoir, and Stillwater on Beaver river, in Herkimer county, was selected as the best location.

A preliminary survey was made at this location in September, 1884, and plans and an estimate of cost for a tree dam, 350 feet in length, were prepared and forwarded in October that year, to the State Engineer and Surveyor for his approval.

In 1885 an agreement was entered into between the State and Theodore B. Basselin, and a contract drawn up for the construction of the Beaver River dam, but for some technical reason the contract was not fully executed and signed until July 31, 1886. The work of construction, however, began in the fall of 1885.

Chapter 330, Laws of 1886, appropriated the further sum of \$1,000 for the construction of reservoirs upon Independence and Beaver rivers, and re-appropriated the following sums, viz.:

The \$6,000 appropriated by chapter 336, Laws of 1881, the unexpended balance of \$5,804.73 of the \$6,000 appropriated by chapter 362, Laws of 1882, and the balance of \$2,003.30 remaining of the \$6,000 provided by chapter 551, Laws of 1884.

The total amount available under this last act was \$14,808.03.

The Beaver River dam as built had a spillway 149 feet long by 9½ feet in height above the natural low water surface of the river at that location.

The dam was completed in 1886 at a cost of \$10,731.92, exclusive of engineering, inspecting and land damages.

Chapter 452, Laws of 1883, entitled "An act to authorize the Superintendent of Public Works to construct a reservoir on the Black river above Forestport pond at Forestport, Oneida county, and making an appropriation therefor," appropriated \$20,000 and directed the Superintendent to construct said reservoir for the purpose of storing water for canal purposes.

By request of the Superintendent of Public Works, a plan and estimate was made for a wooden dam of the crib form, and as the amount appropriated would not admit of a dam higher than 10 feet above the pond, the Superintendent concluded it was not

worth while to begin the work until money was provided for building a dam after a more desirable and serviceable plan, therefore took no further action in relation to it in 1883 except to ask the Legislature for an additional appropriation.

In 1884, however, becoming fully convinced that the proposed reservoir, if built and brought into use at this desirable location, would aid in procuring the needed additional supply of water, better than anything else that could be done for the money it would cost, the Superintendent decided to begin the work with the funds at hand and trust to future legislation for means to complete the work.

And as the act of 1883 did not require, in expressed terms, that the work should be done by contract, the Superintendent appointed good, reliable foremen as managers and had the work done by the day.

Fourteen thousand one hundred and seventy-two dollars were expended in the fall of 1884 upon preparatory work for the dam.

The grubbing and clearing was done, a boarding house, blacksmith shop and storehouses erected, considerable excavation done, roads constructed, and 600 cubic yards of stone for the abutments quarried, the majority of them dressed, some of them delivered and the balance deposited at the canal ready for shipping.

A revised plan for the dam at head of Forestport pond was prepared in the fall of 1884. The new plan provided for stone abutments, also for a stone cross-walk through the cast iron feed-pipes were to be laid, but the spillway was to be of timber (as per plan prepared in 1883), built in the crib form and filled with stone. The length of the spillway to be 200 feet, and its crest 15 feet above the surface of the pond.

Notwithstanding the earnest request of the State officials each year for an additional appropriation to be used in constructing the reservoir above Forestport pond, six years went by after the act of 1883 authorized the construction of said reservoir, before their requests were complied with.

At North Lake reservoir, the down stream ends of the five discharge culverts, between the gates and the apron, were rebuilt, and roads leading to the reservoirs were repaired in 1884.

In 1887 the dam at the foot of the Second Bisby Lake broke away with the spring freshets, and the water so suddenly discharged into the Third Bisby carried away a portion of the dam in the old outlet of that lake, and damaged, to some extent, the bulkhead in the new outlet at the west end of the lake.

About 40 feet in length of the embankment at each dam was carried away. Complete repairs were made that year.

The gates at North Lake, South Lake, Sand Lake and Chub Lake reservoirs were repaired in 1888.

March 8, 1888, the Senate addressed to the State Engineer and Surveyor the following preamble and resolution:

“Whereas, It is alleged that the State of New York is diverting from their natural courses the waters of the Black river for canal purposes, and that the waters so diverted are essential for manufacturing purposes on said river; and,

“Whereas, Manufacturing business along said river suffers from such diversion, by reason of the natural decrease of the tributaries from whose banks and water-shed the forests have been cut, and owners of water power engaged in such manufacturing business have never been protected against such diversion by artificial means for storing water during the spring months; and,

“Whereas, The water of adjacent streams could be used for providing for a partial equivalent for water so diverted; therefore,

“Resolved, That the State Engineer and Surveyor be directed to investigate the allegations above recited, by making an examination of the question; gathering the necessary data by going upon the ground, if that be necessary; referring to the records of the Canal Board, and, in such other ways as he shall deem advisable, inform himself, in order to report to the Senate whether an equitable obligation exists upon the part of the State, to make provision for the protection of riparian owners

against further diversion of water by erecting a reservoir at some point in either Hamilton, Herkimer or Lewis counties, which shall accomplish that purpose."

In compliance with the foregoing resolution, the State Engineer and Surveyor, Hon. John Bogart, and assistant engineer in charge, Mr. Aug. S. Kibbe, made careful investigations of the history of this water supply, examined the reservoirs, lakes and streams from which the supply was drawn, and made able and interesting reports upon the subject.

Their examinations and reports corroborate the estimates made by former engineers in regard to the amount and distribution of water taken from the Black river, viz.: Of the 16,000 cubic feet per minute taken from Black river into the feeder at Forestport, 11,000 of it goes south from Boonville to the Erie canal at Rome, and the remaining 5,000 cubic feet per minute supplies the Black River canal north of Boonville and passes into, and is restored to the Black river at Lyons Falls.

The amount diverted to the Erie canal is placed, therefore, at 11,000 cubic feet per minute during each season of navigation.

The North Woods reservoirs in use at that time, and their estimated available capacities, are given on page 285, State Engineer's annual report for 1888, as follows:

NAME	Mean area. Acres.	Mean depth. Feet.	Total capacity. Cubic feet.	Available capacity. Cubic feet.
White lake	298	5	4 300	84,000,000
Chub lake	200	4	3 300	.....
Sand lake	306	15	15 100	209,000,000
Woodhull lake	1,118	18	37 100	438,000,000
First, Second, Third, Blabys .....	.....	3½	4 300	40,000,000
Causchagala lake	320	4	5 300	56,000,000
North lake	277	28	33 300	676,000,000
South lake	372	36	41 120	350,000,000
Twin lakes	176	8	4 300	100,000,000
Sixth Fulton chain	109	.....	.....	1,884,000,000
Seventh Fulton chain	367	10½	.....	1,000,000,000
To which should be added First, Second, Third and Fourth Fulton chain .....	.....	.....	.....	500,000,000
Beaver river	1,675	9	.....	322,000,000
Total .....	.....	.....	.....	3,012,000,000

Making a total of, say 3,000,000,000 cubic feet; or enough to afford 16,000 cubic feet per minute for 130 days; or 11,000 cubic

feet per minute for 189 days; or 23,000 cubic feet per minute for 90 days; or 34,000 cubic feet per minute for 60 days.

These reservoirs are classified, in said report, into three sections or groups, according to the channels through which they are brought into use:

First. Reservoirs impounding the headwaters of the Black river.

Second. Reservoirs impounding the headwaters of the Moose river.

Third. Reservoirs impounding the headwaters of the Beaver river.

The Black river system comprises Woodhull, White, Chub, Sand and First, Second and Third Bisby lakes, discharging through Big Woodhull creek into the eastern side of the Forestport pond at head of the feeder. Also, North, South, Canachagala and Twin lakes, discharging through the river proper into the southern end of the same pond.

The Moose river system is that formed by two reservoirs on the Fulton chain of lakes, one including First, Second, Third and Fourth lakes, and the other Sixth and Seventh lakes; discharging through that river into the Black river, a few rods above Lyons Falls.

The Beaver river system contains but one reservoir, that at Stillwater; whose waters are conveyed by that stream to the Black River at Castorland, 32½ miles below Lyons Falls.

Notwithstanding that the combined storage capacity of these reservoirs was large, they failed every real dry season, and sometimes even in an ordinary season, to furnish the requisite amount of water for the canals, and to restore to Black river the quantity diverted to the Erie canal.

One reason why they did not furnish a better supply is explained in the annual report of the State Engineer for the fiscal year ending September 30, 1888.

On page 15 of said report the State Engineer and Surveyor says:

“The actual storage capacity of all the reservoirs combined

is very large, but evidence, which seems to be conclusive, has been given that there still exists a great lack of water supply during the dry season along the valley of the Black river.

“The reasons why the large storage capacity of the various reservoirs has not been sufficient to provide a greater dry weather flow are stated in detail in the report of Mr. A. S. Kibbe, the assistant engineer in charge of the examinations made under my direction during the past summer.

“These reasons are, in short, the inaccessibility of the large impounded lakes at the head of the Black river and Moose river, their distances from each other, and the constant use of the water surreptitiously, by lumbermen, for the purpose of floating logs down the stream.

“The funds at the disposal of the Superintendent of Public Works are not large enough for the employment of sufficient guards to prevent this surreptitious use of the water. The fact is that the water is constantly drawn from these reservoirs in the woods at times when it is not needed for the canals or for the manufacturing interests on the Black river. This water flows through the river, flows over the dam at Forestport, and is lost from the impounding reservoirs.”

The State Engineer urged the construction of the reservoir at the head of Forestport pond (for which a law was passed and a small appropriation granted in 1883), and pointed out the advantage of a reservoir at this desirable location, where it could be readily guarded from surreptitious uses, and from whence its waters could reach the canals in a few hours, instead of the days that were required for its passage from the reservoirs at the head waters of the river. He recommended, also, the raising of Beaver River dam.

The Legislature responded to his appeals by granting, in 1889, an additional appropriation for the reservoir above Forestport pond, and providing in 1892 the means for raising the dam at Stillwater, on the Beaver river.

Chapter 274, Laws of 1889, appropriated \$45,000, “For the completion of a reservoir on the Black river above Forestport

pond in Oneida county. * * * For the purpose of storing water for canal purposes."

A clause in the third section of this act directed that the Superintendent of Public Works, "Shall on or before the first day of August, 1889, remove the gate in the dam of Second Bisby lake in Herkimer county and the gate in the dam of White lake, Oneida county, and no gate shall hereafter be placed in the dams of said lakes.

"Said dams shall be abandoned on or before said date and said lakes shall not thereafter be dammed for the purpose of supplying water for the canals."

The Superintendent, however, declined to carry into execution said clause of the third section of the law, claiming that, as these lakes had been appropriated and converted into reservoirs by the State for the purpose of procuring the necessary supply of water for the Black river and Erie canals, they were useful auxiliaries and really an essential part of the system of said canals, which the Constitution of the State of New York declares, "The Legislature shall not sell, lease or otherwise dispose of."

Notwithstanding this decision and action of the Superintendent of Public Works, however, the "Bisby Club" at the Bisby lakes, and the owners of the land bordering on White lake, took the matter into their own hands, under the sanction of the law, and since 1889 the State has not had the use of any impounded waters from said lakes.

The dam, bulkhead and gates at the foot of Second Bisby lake, remain inact, but the gates were controlled by the Bisby Club from 1889 to 1891, and since then have been taken charge of by the "Adirondack League," and said gates have been and are manipulated solely for and to the best interest of the members of said club and league.

The gates are opened to get rid of surplus waters and closed during the dry seasons. In this way the surfaces of First and Second Bisby lakes are kept at a very desirable (for pleasure seekers) and uniform elevation. I found the gates closed and

"flash boards" over them in October, 1897, and the water in Second Bisby $2\frac{1}{2}$ feet higher than it was in the outlet between Second and Third Bisby lakes.

The dam, bulkhead and gates across the old outlet at the south side of the Third Bisby, remain intact, but the gates to the bulkhead in the new outlet at the west end of the lake have either decayed, been carried away by high water, or purposely removed.

The bulkhead and gates were removed from the dam at White lake in 1889, consequently the canals have had no water from that lake since that date, except the natural flow.

June 20, 1889, the deputy State Engineer and Surveyor directed the division engineer of the Middle Division to have a re-survey made for the reservoir dam at head of Forestport pond, and to prepare plans and an estimate for completing the work under chapter 274, Laws of 1889.

Preliminary measurements were taken to show the amount of work done and remaining to be done, and a map, plans and an estimate of cost to complete the work were transmitted to the State Engineer and Surveyor the 9th day of July.

The estimated cost to complete the dam was \$71,000. This was afterwards reduced to \$69,000 by a slight modification of the plan and by charging a higher price for the stone that had been quarried and dressed for the work under the direction of the Superintendent of Public Works in 1884.

As the appropriation was only \$45,000, two or three efforts were made to let the work before a legal bid was received that was low enough to come within the amount appropriated.

But finally the work was let to Philip McGuire of Forestport. His bid amounted to \$49,847.50, or \$44,847.50 net, after deducting \$5,000 for the State stone on hand.

He entered into contract for building the dam September 20, 1895.

The plans and estimates for the dam were adopted by the Canal Board December 27, 1899, at which time \$4,115 were set apart from the appropriation for engineering.

The contractor commenced procuring and delivering material

for the dam in the winter of 1889-1890, and began its construction in the spring of 1890. The work progressed satisfactorily until August, 1891, when it was suspended for want of funds.

The contractor expressed a willingness to continue the work and complete the dam, provided he could be assured that the next Legislature would appropriate the money to reimburse him; but as no such assurance could be given, he asked for a cancellation of his contract, which was granted by the Canal Board, and a final account for the materials delivered and labor performed by him was rendered October 11, 1891.

His final account amounted to \$39,505.07.

New bulkheads were put in at the reservoirs at the Twin and Canachagala lakes in 1890.

The North Lake reservoir dam came very near being swept away again during a very severe rainstorm in September, 1890. The water rose rapidly in the reservoir and despite the desperate efforts put forth by the keeper and all the help he could muster in that immediate vicinity, they failed to open the large, unwieldy wooden gates.

More help was sent for in great haste, and the gates were finally raised, but not until the water had reached to such a height that it was pouring over the south dam at a fearful rate.

The dams are earth embankments, built across two gorges. The one south of the intervening, natural high ground, was lower than the north one, but fortunately it was well paved with large stone. Had it not been, it could not have withstood the scouring it received, for the effects of the scouring were plainly visible the following September, a year from the time the water ran over it.

Chapter 342, Laws of 1891, appropriated \$15,000 for clearing the flow ground of the reservoir above Forestport pond.

Plans, specifications and estimates for clearing the flow ground of the reservoir above Forestport pond were adopted by the Canal Board and \$2,000 set apart for engineering, June 10, 1891.

June 30, 1891, we were notified that the Superintendent of Public Works decided not to let the clearing of Forestport reser-

voir, as the appropriation was not sufficient to cover the lowest bid and the engineering.

Chapter 494, Laws of 1892, appropriated the sum of \$35,000 for completing the reservoir dam at head of the Forestport pond, and the sum of \$14,000 for changing the alignment and grades of highways that would be submerged by the construction of said dam.

Maps, plans, estimates and specifications for completing the dam for reservoir at the head of the Forestport pond, and for raising the roads and bridges over said reservoir, were adopted by the Canal Board.

July 20, 1892, the work was let to complete the dam for the reservoir above Forestport pond and for raising the roads and bridges over said reservoir, under chapter 494, Laws of 1892.

The clearing of the flow ground of said reservoir, under chapter 342, Laws of 1891, was also let on the 20th of July, 1892.

The three pieces of work were awarded to Beckwith & Quackenbush and they entered into contract for the same, July 26, 1892.

Their bid for completing the dam amounted to the net sum of \$30,780, and for raising roads and bridges to \$11,902.50, and for clearing the flow ground to \$11,000.

The work of raising the roads and bridges on Black river reservoir above Forestport pond was completed in the summer of 1893, and a final account rendered for the same August 12th of that year.

The clearing of the flow ground of said reservoir was not completed.

By request of the contractors the Canal Board cancelled their contract for the clearing December 28, 1893.

Chapter 496, Laws of 1894, reappropriated the unexpended balance of \$7,793.96 of the sum appropriated by chapter 494, Laws of 1892, for completion of the reservoir on Black river above Forestport pond.

The dam for said reservoir was completed in January, 1894, and the reservoir was brought into use that year.

The following is a summary of the appropriations for the reservoir on Black river at the head of the Forestport pond:

FOR THE DAM.

Chapter 452, Laws of 1883, appropriated.....	\$20,000 00
Chapter 274, Laws of 1889, appropriated.....	45,000 00
Chapter 494, Laws of 1892, appropriated.....	35,000 00
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Total for dam	\$100,000 00

FOR CLEARING THE FLOW GROUND.

Chapter 342, Laws of 1891, appropriated.....	15,000 00
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FOR RAISING ROADS AND BRIDGES	
Chapter 494, Laws of 1892, appropriated.....	14,000 00
<hr/>	
Total	\$129,000 00
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The sums expended in constructing the reservoir on Black river, at the head of Forestport pond, were as follows:

DAM.

In 1884, by Superintendent of Public Works, chapter 452, Laws of 1883.....	\$14,172 00
In 1890-91, McGuire contract, chapter 274, Laws of 1889	39,505 07
In 1892-93-94, Beckwith & Quackenbush contract, chapter 494, Laws of 1892.....	27,952 31
<hr/>	
Total for dam	\$81,629 38

RAISING ROADS AND BRIDGES.

In 1892-93, Beckwith & Quackenbush contract, chapter 494, Laws of 1892.....	11,907 97
<hr/>	
CLEARING RESERVOIR FLOW GROUND.	
In 1892-93, Beckwith & Quackenbush contract, chapter 342, Laws of 1891.....	9,350 00
<hr/>	
Total	\$102,887 35
<hr/>	

Exclusive of surveying, engineering, inspecting, advertising, printing and land damages.

Chapter 472, Laws of 1893, reappropriated the sum of \$5,597, being the unexpended balance of the appropriation made by chapter 342, Laws of 1891, for clearing flow ground or reservoir above Forestport pond.

Chapter 469, Laws of 1892, entitled "An act to restore to the owners of water power of the Black river the water diverted by the State for canal purposes," appropriated \$15,500 for enlarging and raising the tree dam at Stillwater on Beaver river.

Said dam to be raised 5 feet, "as recommended by the State Engineer and Surveyor in his report to the Senate, dated January 18, 1889."

Section 2 of said act authorized the Superintendent of Public Works to appoint a gate-tender for the dam, whose pay was not to exceed \$3 per day.

August 3, 1892, plans and estimates were transmitted to the State Engineer and Surveyor for raising the tree dam on Beaver river at Stillwater, and for constructing bridges over Twitchell creek and across the reservoir flow ground.

Map, plan and estimate for raising the tree dam on Beaver river at Stillwater were adopted by the Canal Board November 14, 1892.

August 30, 1892, the work was let for raising the dam at Stillwater on Beaver river, under chapter 469, Laws of 1892, and was awarded to F. Louis Faass & Co. The aggregate of their bid was \$13,220. They entered into contract for the work September 6, 1892.

The work of raising the dam 5 feet at Stillwater on Beaver river by contract, under chapter 469, Laws of 1892, commenced in September, 1892, and was completed in the fall of 1893. The final account for the same was rendered December 19, 1893, and amounted to the sum of \$11,724.17.

Chapter 119, Laws of 1893, appropriated \$5,000 for clearing the flow ground of the reservoir on Beaver river at Stillwater.

Chapter 224, Laws of 1893, entitled "An act to restore, by con-

structing bridges, the Lake Champlain and Carthage road, rendered impassable by reason of the State dam being built at Stillwater on the Beaver river," appropriated \$5,000 for building bridges over Twitchell creek and over the flow of the water caused by the building of the State dam.

An attempt was made to let the work of constructing bridges and their approaches over Twitchell creek and the road where submerged by the reservoir water, but the lowest bid received was considerably in excess of the sum appropriated by chapter 224, Laws of 1893; consequently the "Lake Champlain and Carthage road" has not been restored to public travel across the Beaver River reservoir, except by ferry in small boats for foot passengers.

Chapter 648, Laws of 1893, appropriated \$2,500 for repairing the State road leading from Lane's mill to South Lake reservoir, and \$2,496.87 of the appropriation was expended that year repairing said road.

Chapter 726, Laws of 1893, provided \$8,500 for constructing a sluice in the spillway at the foot of North Branch reservoir.

Chapter 219, Laws of 1895, reappropriated the unexpended balance of \$2,839.

The work was done in 1894-95 by A. C. Hall, under his contract dated September 11, 1894.

Final rendered July 18, 1895, amounted to the sum of \$6,175.69.

Chapter 168, Laws of 1894, entitled "An act in relation to the State dams on the Beaver and Moose rivers," authorized the Governor "to appoint from time to time, and at his pleasure remove, three citizens of Jefferson county and one from Lewis county, interested in the use and owners of water power on the Black river, Beaver river or Moose river, in such counties, to be commissioners of water power on Black river. Such commissioners shall not receive compensation for their services.

"Such commissioners are authorized to appoint one gatekeeper for the State dam at Stillwater, on the Beaver river, and one gatekeeper for the dams constructed by the State on the Fulton Chain of Lakes and Moose river."

The commissioners were authorized to make rules and regulations for the management of the gates in said dams, subject to the approval of the Superintendent of Public Works.

Chapter 768, Laws of 1894, appropriated \$1,000 for compensation of gate-tenders on the Beaver and Moose rivers, as provided for by chapter 168, Laws of 1894.

Chapter 396, Laws of 1894, entitled "An act to confer jurisdiction upon the Board of Claims to hear, audit and determine the claim of Beckwith & Quackenbush against the State."

This act authorized the Board of Claims to hear and determine the claim of Beckwith & Quackenbush for work and services performed for the State, and for articles furnished in clearing the flow ground of the reservoir of the Black river above Forestport pond, and award thereon such sum as a reasonable compensation, over and above any payments already made, as in the judgment of said Board should be just and equitable.

The claimants were given a hearing by the Board of Claims at a meeting held in Utica in May, 1894.

The Superintendent of Public Works expended, in clearing the flow ground of reservoir on Beaver river at Stillwater:

In 1894, pursuant to chapter 119, Laws of 1893, \$2,265.04, and in 1895, out of the sum of \$2,434.93, reappropriated by chapter 219, Laws of 1895, \$2,427.

Chapter 148, Laws of 1895, appropriated \$25,000 and authorized and directed the Superintendent of Public Works "to repair or reconstruct the controlling gates, bulkhead and culverts on the North Branch reservoir and the State road leading from the North Branch reservoir to the South Branch reservoir, in the town of Wilmurt, county of Herkimer, in accordance with plans and specifications to be furnished and approved by the State Engineer and Surveyor."

August 28, 1895, a contract was made with Michael Bennett for improving the road and lengthening the spillway at North Branch reservoir, pursuant to chapter 148, Laws of 1895.

Under this contract the alignment of the road was changed from its circuitous route where it crossed the spillway outlet below the chute, to the more direct course, and a safer place for the bridge, directly over the bulkhead and new spillway.

The work done consisted of the construction of two stone abutments and a stone pier, retaining walls, the erection of two new wood truss bridges and a stringer bridge, the transferring of the old bridge to the new location, the opening, clearing and grading of about 1,000 lineal feet of new road, and the lengthening of the paved spillway.

The two new bridges east of the chute have a clear span of 43 feet each, and the old bridge on the west side, a span of 50 feet. These, with the 10 feet opening of the chute, afford a passageway 146 feet in width for flood waters.

This improvement was greatly needed, and one for which State officials had been importuning the Legislature to provide means to make for forty years.

The work was done in the fall of 1895, and the final account rendered in February, 1896, amounted to the sum of \$5,240.38.

The improvement should have been extended still further by constructing overfalls and a paved waste to convey the water safely from the present new works to the low ground at and beyond the foot of the chute. As now left, there is danger that during an extreme and protracted freshet, the water will scour away the sandy soil south of the spillway, to a depth that will undermine the paving. If this should occur, serious consequences would follow.

In 1896, pursuant to chapter 148, Laws of 1895, four cast iron pipes, 30 inches in diameter, with the necessary valves, well and gatehouse, were substituted for that portion of the five old wooden culverts located between the old gates and foot of dam at North Branch reservoir.

The work was done by John H. Nelson, under his contract dated August 29, 1895.

Engineer's estimate for the work was.....	\$17,983 50
Engineer's estimate at contract price.....	16,764 50
And final estimate, rendered February 25, 1897....	17,316 05

The act which authorized this improvement did not provide sufficient funds for doing the work in the manner first contemplated, and the way it should have been done, namely: Removing

the old timber culverts for their whole length and substituting therefor and extending the iron pipes entirely through the bank.

The additional amount that it would have cost to do this would have been a wise and economical expenditure of money, for it is merely a question of time before this will have to be done; and it should not be delayed too long, for the water in this reservoir is frequently drawn down so low as to expose portions of this timber work, and every exposure impairs its stability.

By substituting iron and stone for the remaining portions of these old wooden culverts, and extending the improvements at the spillway as suggested, this important reservoir would be in a condition to withstand the effects of the severe freshets that are so liable to occur in that locality.

The extensive water-shed at North lake, makes that reservoir the most desirable and useful of any in the North Woods, but, at the same time, subjects it to sudden and excessive freshets, and for both of these reasons it should be kept in such repair as to insure against possible failure, for if it should fail, the canals would be deprived of the large amount of water it furnishes, and its breaking away would saddle upon the State for damages, an amount ten times greater than what it would cost to make the reservoir secure against any probability of failure.

Chapter 790, Laws of 1897, appropriated \$2,256.58 deficiency in appropriation for repairs on the North Branch reservoir pursuant to chapter 148, Laws of 1895.

Chapter 606, Laws of 1898 provides for balance due on contract and interest thereon, for repairs on the North Branch reservoir, pursuant to chapter 148, Laws of 1895, the sum of \$142.92.

Chapter 219, Laws of 1895, re-appropriated \$4,757.17, being the unexpended balance of the appropriation for constructing bridges over Twitchell creek, pursuant to chapter 224, Laws of 1893.

Chapter 807, Laws of 1895, appropriated \$1,100 "For the compensation of gate tenders for the State dams upon the Beaver and Moose rivers as provided by chapter 168, Laws of 1894."

Chapter 932, Laws of 1895, appropriated \$5,000 for repairing the State dam on Beaver river, and the State dams on the Fulton chain of lakes, and for building keeper's house and necessary dredging, to be expended by the commissioners appointed by chapter 168, Laws of 1894, under the supervision of the Superintendent of Public Works.

Chapter 66, Laws of 1896, appropriated \$24,500 to pay awards made by the Supreme Court under chapter 759, Laws of 1894, to riparian owners on the tributaries of Beaver river.

Chapter 795, Laws of 1896, entitled "An act in relation to the State Dams on the Beaver and Moose rivers," is of similar import, and the same in fact as chapter 168, Laws of 1894.

Chapter 1057, Laws of 1896, and chapter 306, Laws of 1897, each appropriated \$1,100 to pay gate tenders at the State dams on Beaver and Moose rivers, as provided by chapter 168, Laws of 1894.

Chapter 572, Laws of 1897, re-appropriated \$2,756.43, being the unexpended balance of the appropriation for repairing State dams on Beaver river and the Fulton chain of lakes, pursuant to chapter 932, Laws of 1895.

About one-half (the north half) of the "Forge" wooded dam on Moose river below the Fulton chain of lakes was repaired and partially rebuilt in the fall and winter of 1897 and 1898. The amount expended in doing this work and in making some repairs to the dam at Stillwater, on Beaver river, was \$3,684.55.

The Superintendent of Public Works expended, repairing reservoirs in the North Woods:

In 1894, the sum of.....	\$2,011 65
In 1895, the sum of.....	1,706 00
In 1896, the sum of.....	1,651 06

And in repairing the North Lake road in 1896, the sum of \$254.40.

Two stone spillways were built in 1896; one at the northwest corner of Woodhull reservoir, and the other at the northeast corner of Canachagala Lake reservoir.

In 1897, under chapter 566, Laws of 1897, there was expended in repairing and improving the North Woods reservoirs, the sum of \$12,418.82. And in clearing, repairing, reconstructing and improving the roads leading to said reservoirs, the sum of \$20,948.37. These repairs and improvements made upon the reservoirs and roads in 1897 were greatly needed, and the money used in doing the work was wisely provided and judiciously expended.

At North Lake reservoir a concrete core was put in the embankment north of the pipes, and the paving at the spillway chute reinforced with concrete and mortar.

Three new steel gates, 3 feet wide by 4 feet high each, were put in the bulkhead at South Lake reservoir, and the discharge channel cleaned out and lowered.

Repairs were made at Twin lakes and the reservoir raised 1 foot and its capacity increased by placing a 12-inch timber upon the spillway of the dam.

A decided improvement was made at Canachagala by building a new stone bulkhead and putting it down sufficiently low to make the lake available as a reservoir 10 feet in depth. The channel each way from the bulkhead was cleaned out and lowered correspondingly so as to permit drawing the water down 10 feet below the top of the spillway located at the northeast corner of the lake.

The method adopted in improving the roads by removing and discarding the light, top soil, consisting mainly of vegetable mold, and in using none but the best of material procurable in that vicinity in forming the road-beds, resulted in putting the roads, so far as the improvement extended, in excellent condition.

As the sum appropriated in 1893 and re-appropriated in 1895, for constructing bridges over Twitchell creek and Beaver River reservoir was insufficient for the purpose, the Legislature in 1897 authorized the money to be used for clearing said reservoir.

The authority was as follows:

The sum of \$4,757.17, being the unexpended balance of the appropriation for bridges over Twitchell creek, pursuant to chap-

ter 224, Laws of 1893, being the sum re-appropriated by chapter 219, Laws of 1895, was re-appropriated by chapter 573, Laws of 1897 for the purpose of clearing the flow ground of the reservoir at Stillwater, on Beaver river, pursuant to chapter 119, Laws of 1893.

Late in the summer of 1897, a break occurred under the bulkhead and gates of the Beaver River reservoir dam at Stillwater, Herkimer county, and was repaired during the months of September, October, November and December of that year, under the supervision of the commissioners appointed by the Governor, pursuant to chapter 168, Laws of 1894.

When making the repairs it was found necessary to strengthen and improve the dam to quite an extent. The amount expended in making the repairs and improvements was \$9,637.45.

This dam was built in 1885-1886, and raised in 1892-1893.

Chapter 593, Laws of 1898, granted \$1,100 "for the compensation of gate tenders for the State dams upon the Beaver river and Moose river, as provided by chapter 168, Laws of 1894.

Chapter 606, Laws of 1898 provides: "For the purpose of building dams supplemental to the State dam on Beaver river, \$7,000; for building keeper's house, \$1,500; for paying deficiency in expenditures of the commissioners appointed by chapter 168, Laws of 1894, \$1,500." "Said moneys to be expended by said commissioners under the supervision of the Superintendent of Public Works, but no dam shall be erected except the plans therefor have been approved by the Forest Preserve Board."

In the following table of the reservoirs in present use, the established capacities of those on Moose and Beaver rivers are taken from pages 285 and 291, annual reports of the State Engineer and Surveyor for the fiscal year ending September 30, 1888.

RESERVOIRS IN USE IN 1898.
For the Erie and Black River Canals, Middle Division.

RESERVOIRS.	Completed. Year.	When brought in use. Year.	Elevation above tide water. Feet.	Watershed. Square miles.	Surface area. Acres.	Average area. Acres.	Average depth. Feet.	Capacity. Cubic Feet.
North lake.....	1856	1857	1,824	265	423	277	25	301,653,000
Woodhull.....	1859	1860	1,878		1,236	1,118	18	876,601,440
South lake.....	1860	1861	2,019		518	372	26	421,312,320
Sand lake.....	1872	1873	1,827		344	306	18	239,928,480
Canachagala lake.....	.....	1881	.....		347	320	10	139,392,000
Twin lakes.....	.....	1881	.....		213	175	9	68,607,000
Forestport reservoir.....	.....	1894	.....		793	700	7	213,444,000
Forestport pond.....	.....	1849	.....		160	150	2	13,068,000
Total.....	.....	.....	.....	.....	4,034	3,418	.....	2,274,006,240

Affording 16,000 cubic feet per minute for 98 days.

RESERVOIRS IN USE IN 1898.
For Black River Improvement and Water Power on Black River.

RESERVOIRS.	Completed. Year.	When brought in use. Year.	Elevation above tide water. Feet.	Watershed. Square miles.	Surface area. Acres.	Average area. Acres.	Average depth. Feet.	Capacity. Cubic feet.
Fulton Chain:								
First lake.....	1881	1882	.....	44	403	.....	.....	500,000,000
Second lake.....	1881	1882	.....		175			
Third lake.....	1881	1882	.....		166			
Fourth lake.....	1881	1882	.....		1,979			
Sixth lake.....	1881	1882	.....		109			
Seventh lake.....	1881	1882	.....	170	867	.....	.....	300,000,000
Beaver river.....	.....	1887	.....		2,681			
Total.....	.....	.....	.....	.....	6,380	.....	.....	1,650,000,000

Affording 11,000 cubic feet per minute for 104 days.

These reservoirs in the aggregate furnish an amount of water ample for ordinary years when the dry weather period does not demand the drawing from them the required 16,000 cubic feet of water per minute for more than three months, or say 100 consecutive days; but for extremely dry seasons, such, for instance, as were experienced in the years of 1849, 1867, 1871, 1879 and 1881, they fall far short of furnishing the required amount.

A careful perusal of the records since the Forestport feeder was brought into use in 1849, affords convincing proof of the fact that whenever a long, dry season has occurred, the canals, as well as the mill powers on the Black river, have suffered for the want of water.

It is true that a part of this shortage can be accounted for from the fact that the lumbermen have sometimes surreptitiously used the impounded water to float their logs.

But a little figuring will show to anyone who will take the time and trouble to make the calculation, that the combined storage capacity of all the reservoirs that have at any one time furnished water to the Forestport feeder, would be unequal to the demand when called upon to furnish the required 16,000 cubic feet of water per minute for a longer time than 100 days in succession.

The reservoirs in present use, and which have been in use since and including the year of 1894, have a storage capacity greater by nearly 200,000,000 cubic feet than those that were in use any year previous to that date.

Still, as the figures in the above table show, these reservoirs in delivering to the Forestport feeder the 16,000 cubic feet of water per minute, would be exhausted in less than 100 days, unless they were replenished during that time by an amount that exceeded the natural loss by evaporation and filtration.

The reports and records show that there have been at least five years during the last half century, or an average of one year in ten, when the dry weather portion of the year lasted about five months, and there have been other years when the drouth continued longer than 100 days.

For all such years it became necessary to resort to extreme measures at considerable expense to procure the additional

amount of water needed to maintain navigation through the extreme and extended dry seasons.

To provide for these protracted dry seasons of five months, or say 150 days' duration, would require reservoirs capable of storing 3,500,000,000 cubic feet of water.

This amount, located where it would flow readily into the feeder at Forestport, would, if properly managed, not only furnish to the canals the required 16,000 cubic feet per minute for 150 days, but would give to Black river, in addition to its natural flow below Lyons Falls, the 5,000 cubic feet of water per minute that supplies and flows through the canal north from Boonville.

The water powers below Lyons Falls are receiving, in addition to the natural flow of the river, the benefit of this 5,000 cubic feet of water per minute from the present reservoirs, so long as the 16,000 cubic feet per minute taken into the feeder is being supplied wholly from the reservoirs. And as these reservoirs are capable of furnishing and do furnish, when rightly managed, that amount per minute for nearly 100 consecutive days, the riparian owners along Black river have no reason to complain. On the contrary, when the dry season is not prolonged beyond three months they have good reason for congratulating themselves and are to be congratulated, for during that period they receive, in addition to the natural flow of the river, not only the 5,000 cubic feet per minute that flows through the canal north from Boonville, but an additional 11,000 cubic feet of impounded water per minute from the reservoirs on Moose and Beaver rivers.

But when the dry weather continues longer than 100 days and the canals are being supplied from the natural flow of the river, the mills from Forestport to Lyons Falls are being deprived of 16,000 cubic feet of water per minute, and those below the falls of 11,000, if the Black river at Forestport affords the 16,000 cubic feet per minute.

It will be remembered, however, that in 1849, before any reservoirs were built, the low water flow of Black river at Forestport was only 9,000 cubic feet per minute. This fact showed conclusively that the natural flow of said river could not be

relied upon during extremely dry seasons to furnish the 16,000 cubic feet per minute, and led up to the building of reservoirs to supply the deficiency.

But eight years went by before the first reservoir was completed and brought into use.

During these years the mills on Black river were short of water so much of the time and their owners presented so many bills and filed so many claims for damages, that it became apparent something must be done to restore to the river an equivalent for the water that was being diverted.

To make the restitution, however, it was quite essential to first know, approximately at least, what amount was being diverted, and the preliminary work of gauging and measuring resulted in the decision that, of the 16,000 cubic feet per minute taken into the feeder at Forestport, 5,000 cubic feet fed the Black River canal north from Boonville and was restored to the Black river at Lyons Falls, and that the remaining 11,000 went to the Erie canal at Rome.

This was the basis for act chapter 326, Laws of 1859, which made an appropriation and directed "the completion of so many of the Black river reservoirs as will, with the least expense, restore to the Black river the 11,000 cubic feet of water per minute, being the quantity diverted to the Erie canal."

If this law had been construed to mean that the reservoirs must be capable of returning to Black river the same amount per minute, during the entire number of minutes for every day each year, that was being taken from said river into the feeder at Forestport, or, in other words, if it meant that the State must impound enough water for its own use each year, so that none of the natural flow of the river would, in effect, be diverted from its natural course, it would have required reservoirs aggregating a storage capacity of more than 5,000,000,000 cubic feet, for there have been, during the past fifty years, an average of 219 days of navigation per year, and the number of minutes in 219 days, multiplied by 16,000, exceeds 5,000,000,000 as above stated.

The amount diverted to the Erie canal during that time, however, would be a little less than 3,500,000,000 cubic feet. But

if these 3,500,000,000 cubic feet limited the capacity of the reservoirs, they would, under the existing conditions of supply and demand, be exhausted in about 150 days, and for the remaining portion of the season of navigation the supply would have to be taken from the natural flow of the river.

The most natural and reasonable interpretation of the law is to consider it to mean that the amount to be restored to Black river is the quantity diverted to the canals during the dry season of the year when its diversion would prove detrimental to the water powers along said river.

The State officials in charge of the canals at the time this law was passed did so construe it, and assumed the dry weather period to be 115 days per year.

Doubtless these 115 days would be a fair average, and possibly more than the real average dry weather days per year for the past fifty years.

And if there had been reservoirs from 1849 to the present time of sufficient capacity to furnish the amount of water taken into the Forestport feeder that number of days each year, and its use had been so managed as to permit the natural flow of Black river or its equivalent, to pursue its course past Forestport for 115 days during the driest portion of each year, it would, without doubt, have amounted in the aggregate to as much more than the quantity diverted to the canals during the dry seasons when the diversion seriously affected the water powers on said river.

But an average amount per year, for a term of years, does not serve the State, the boatmen and the mills the best possible way, for whenever the drouth continues beyond the term for which the reservoirs provide, not only do the water wheels along the Black river stop turning, but loaded boats frequently come to a standstill for the want of sufficient water to float them.

This results in a loss to the boatmen, the State, and, for the time being at least, to the owners of the water powers along the river, the amount of the losses depending materially upon the length of time the dry weather continues after the reservoirs are exhausted.

The losses fall the most heavily upon the boatmen for the reason that they are less able to bear them.

The greatest loss, however, in the end, comes upon the State, and is borne by the people, the taxpayers, in paying to claimants their losses while their mills are idle.

The remedy for this would be to impound an amount of water that would furnish the canals the required 16,000 cubic feet of water per minute for the longest dry season of the year.

If enough reservoirs in number and capacity to do this had been constructed and brought into use at the time the feeder was completed, the cost of their construction and for their maintenance would have been very much less, it is believed, than the amount that has been expended in settling the claims for the diversion of water.

The Adirondack region furnishes a bountiful supply of water.

Great quantities run to waste when the streams are swollen and converted into torrents by the copious rains and melting of the deep snows so prevalent there.

The storing and holding in reserve of this surplus water that goes to waste would not only furnish an amount which, in addition to the natural flow of the streams, would afford a constant supply sufficient for all present needs at least, but the floodwaters held in restraint would reduce the freshet volumes to such an extent as to lessen greatly the liability of damages from them.

Whenever the additional water is impounded to supply the deficiency for the longest dry seasons, it should be stored where it will flow readily to the pond at the head of the Forestport feeder and as close to said pond as it is possible to find locations for reservoirs, so that the water can reach the feeder and canals at short notice. And if near the feeder, they would be less liable to be tampered with by outside parties.

In constructing new reservoirs, or adding to or improving those now in use, iron and stone should be used, if possible and practicable, instead of perishable material.

The total storage capacity of the ten North Woods reservoirs now in use is nearly 4,000,000,000 cubic feet.

This amount used at the rate of 16,000 cubic feet per minute would hold out for 170 days if, during that time, the rainfall in

that vicinity was sufficient to make up for the natural losses by evaporation and filtration.

Therefore, if all of these reservoirs were where the water from them could flow to the feeder, the supply would be abundant for the longest dry season. Or if the water from the summit level at Boonville went but one way, so that only the 11,000 cubic feet of water per minute diverted to the Erie canal was taken from Black river into the feeder at Forestport, then the seven reservoirs and the pond that now send their waters to the feeder and the canal would last nearly to the end of the longest recorded dry season.

But as one of the main objects for which the Black River canal was constructed was to provide a way for the boats to pass between the Erie canal and the navigable portion of the Black river, it was necessary to have enough water to supply the Black River canal both ways from the summit level, besides the amount sent to the Erie canal from the south end of the summit, through Lansing Kill, the Mohawk river and the feeder at Rome.

And the necessity for furnishing the additional water to supply the canal north of Boonville was why the Forestport feeder was made larger than the Black River canal. (Sections of the canal and feeder are shown in this report.)

There have been no extremely dry seasons since the completion and subsequent raising of the dams on Moose and Beaver rivers to demonstrate, in a practical way, whether the waters from the present reservoirs, together with the natural flow of the streams, will be sufficient to maintain navigation on the Black river improvement, through a protracted dry season.

But if it should be found that more water is needed for said river improvement, places should be selected where the impounding of it and the frequent and extreme changes between its high and low stages would not convert into desolate wastes those beautiful summer resorts, so eagerly sought and highly prized by the multitude of seekers for health, pleasure and recreation.

MAPS.

Section 4 of chapter 338, Laws of 1894, directs that: "There shall be kept on file in the office of the State Engineer, complete manuscript maps and field notes of every canal now or hereafter

to be built, and of all the lands belonging to the State adjacent thereto or connected therewith, in which the boundaries of every parcel of land to which the State shall have a separate title, shall be designated, and the names of the former owners and the date of each title entered.

“The expense of all such maps and field-notes shall be paid out of the appropriation made for the support and maintenance of the canals.

“All such maps and field-notes, approved by the Canal Board or Canal Commissioners or certified by such board or commissioners or by the State Engineer to be correct, shall be presumptive evidence of the truth of the facts therein stated and of the ownership by the State of the lands therein described.”

Section 5 says: “A copy of every map and of all field-books and notes so filed, or of such part thereof as relates to the canal lands in any county, certified by the State Engineer to be a correct copy thereof, shall be filed in the clerk’s office of such county, and shall be evidence with like force and effect as the original maps and field-notes of which it is a copy. Transcripts of a part of any such map or field-notes, certified by the officer having the custody of the original or certified copies from which they are made, to be correct copies thereof, shall be evidence as to the parts contained in such manuscripts, with the same force and effect as if the originals were produced.”

A clause in section 2 of this act says: “The term canal as used in this chapter, includes all the side-cuts, feeders and other works belonging to the State connected therewith.”

MAPS ON FILE IN THE OFFICE OF THE STATE ENGINEER AND SURVEYOR.
Maps Adopted by Resolution of the Canal Board and Officially Signed.

RESERVOIRS.	Law.		Signed and submitted by the Division Engineer.	Examined, approved and signed by the State En- gineer.	Adopted by resolution of Canal Board and signed by Auditor.
	Chap.	Year.			
North Branch reservoir.....	181	1851	October 28, 1851	October 28, 1851	October 28, 1851
Woodhull reservoir	181	1851	October 28, 1851	October 28, 1851	October 28, 1851
South Branch reservoir, No. 2	181	1851	October 28, 1851	October 28, 1851	October 28, 1851
South Branch reservoir, No. 1	181	1851	November 12, 1851	November 12, 1851	November 12, 1851
North Branch reservoir.....	329	1854	September 11, 1854	September 12, 1854	September 12, 1854
Woodhull reservoir.....	329	1854	September 11, 1854	September 12, 1854	September 12, 1854
South Branch reservoir, No. 2	326	1859	July 11, 1855	September 11, 1855	September 12, 1854
Chub Lake reservoir	326	1859	July 11, 1855	July 11, 1855	July 11, 1855
Road to North Branch reservoir.....	.....	.....	(*)	(*)	July 11, 1855
Forge Dam, Moose river.....	399	1874	July 28, 1874	(*)	July 30, 1856
White Lake reservoir.....	493	1880	June 17, 1880	June 29, 1880	October 2, 1874
Reservoir above Forestport pond	274	1889	.....	.....	† July 1, 1880
					† December 27, 1889

* Signed, not dated. † Not signed by Auditor.
The survey notes are tabulated in full on the maps of North Branch, Woodhull No. 2, on South Branch and Chub Lake reservoirs; and the courses and distances are recorded along the flow lines of the maps of White Lake reservoir and the reservoir at the head of Forestport pond.

**MAPS CERTIFIED TO BY THE RESIDENT ENGINEERS
AS HAVING BEEN EXHIBITED FOR LETTINGS.**

Map of reservoir No. 1, on South branch of Black river, exhibited at Rome for a letting held in Albany November 18, 1851.

Map of reservoir on North branch of Black river, exhibited for a letting held at Lyons Falls October 12, 1854.

Map of reservoir at Chub lake, exhibited at lettings held at Lyons Falls October 12, 1854, and re-exhibited at a letting held in Boonville May 19, 1859.

Map of reservoir at Chub Lake, exhibited at lettings held at Lyons Falls February 14 and April 22, 1856.

Map of reservoir on South branch of Black river, exhibited at lettings held at Lyons Falls February 14 and April 22, 1856, and at Boonville May 19, 1859.

Maps of roads from the head of the feeder to Chub Lake and South Branch reservoirs, exhibited at lettings held at Lyons Falls February 14 and April 22, 1856.

ALSO THE FOLLOWING.

A large map showing the location of the reservoirs being constructed for Black River canal in 1856.

Three maps drawn to a scale of two chains to an inch, with the survey notes (courses and distances) recorded along the flow-lines, namely:

Canachagala Lake reservoir, surveyed by C. L. Phelps in July, 1880; Twin Lake reservoir, surveyed by C. L. Phelps in August, 1880; reservoirs on the Bisby lakes, consisting of the first, second and third Bisbys, surveyed by C. L. Phelps in February and March, 1881.

Map of Sixth and Seventh lakes of the Fulton chain, surveyed by C. L. Phelps in January, 1881. And on the same sheet, a map from survey of C. L. Phelps in August 1880, showing the permanent appropriation for the "Forge Dam," on Middle Branch of the Moose river.

Map of "Proposed Black River reservoir near Forestport," drawn by D. Richmond in 1883, from survey by C. L. Phelps in 1881.

Map of Beaver River reservoir, showing flow-line as far as completed by C. L. Phelps, surveyor, in 1888. A letter dated February 23, 1888, from Denison Richmond, division engineer, to Hon. John Bogart, State Engineer and Surveyor, is attached to this map.

Map of the Black River canal with the watershed of the Black river and showing the reservoirs in use in 1888. This map shows the lakes and tributary streams to Black river, from their sources to the mouth of Black river, where it enters Lake Ontario at Sacketts Harbor.

Map of Black River reservoir at the head of Forestport pond (in progress).

1891.

Area within flow-line, 793 acres.

Map for cleaning flow-ground of reservoir above Forestport pond. Chapter 342, Laws of 1891. Signed and transmitted by the division engineer, June 18, 1892; examined, approved and signed by the deputy State engineer and surveyor, July 5, 1892, and exhibited at a letting July 20, 1892.

Map showing lands proposed to be flooded and appropriated to the use of the State for Black River reservoir at the head of Forestport pond. Chapter 494, Laws of 1892.

Map of reservoir on the Black river near Forestport, showing condition of the clearing on contract of Beckwith & Quackenbush on the 18th of November, 1893.

Map of part of the Beaver River reservoir; showing the overflow on lands of the Adirondack Timber and Mining Company, Mary L. Fisher, and the Waldorf Forest Company. Area of land condemned as follows:

	Acres.
Adirondack Timber and Mining Company.....	348.8
Mary L. Fisher.....	2,754.0
Waldorf Forest Company.....	369.5
	<hr/>
Total	3,472.3
	<hr/> <hr/>

ACRES FLOODED.

	Acres.
Land of Mary L. Fisher.....	1,600
Land of J. Dunbar.....	75
Land of Adirondack Timber and Mining Company.	100
Land of Dr. Webb.....	1,434
Total	3,209

Map of Lake Lily and Little Woodhull, with the courses and distances recorded along the flow-line. These lakes and Gull lake were surveyed by C. L. Phelps in 1881 for "proposed reservoirs." The outlets of these lakes were lowered, but no dams were built.

MAP SHOWING RESERVOIRS IN HERKIMER COUNTY,
LOCATED BY C. L. PHELPS, SURVEYOR, IN 1880 AND
1881.

Old reservoirs.

	Acres.
Woodhull	1,236
North lake	432

New reservoirs.

Canachagala Lake	347.51
Twin Lakes	212.72
First Bisby Lake.....	156.93
Second Bisby Lake.....	129.27
Third Bisby Lake.....	41.61

Proposed reservoirs.

Lily Lake and Little Woodhull Lake.....	266.50
Gull Lake	152

The area of Second Bisby lake, including the land flooded, is 204.71 acres.

MAPS ON FILE IN THE OFFICE OF THE SUPERINTEND-
ENT OF PUBLIC WORKS.

Map for clearing Beaver River reservoir at Stillwater, Herkimer county, chapter 119, Laws of 1893, signed and transmitted by the division engineer in May, 1893; examined, approved and

signed by the deputy State engineer and surveyor, June 2, 1893, and adopted by resolution of the Canal Board and signed by the acting clerk, June 2, 1893.

Maps of 64 parcels or pieces of land, aggregating 753.47 acres, permanently appropriated for a reservoir at the head of Forestport pond, in Oneida county, for the use of the State for canal purposes. Copies of these maps for the said 64 parcels of land are also on file in the office of the State Engineer and Surveyor at Albany, in the office of the division engineer at Syracuse, and in the county clerk's office in the city of Utica, Oneida county.

Map of Beaver River reservoir, certified to July 8, 1898, by the resident engineer as an accurate map from an actual survey; examined, pronounced correct and signed by the State Engineer and Surveyor, July 14, 1898; signed by the deputy superintendent of Public works, July 14, 1898; and filed in the office of the State Engineer and Surveyor as a permanent appropriation for the use of the canals.

The areas of land condemned are as follows:

Lands of Mary L. Fisher.....	2,754.0
Lands of Waldorf Forest Company.....	369.5
Lands of Adirondack Timber and Mining Company.	348.8
	<hr/>
Total	3,472.3
Aggregate of acres flooded.....	3,209.0
	<hr/> <hr/>

PLANS ON FILE IN THE OFFICE OF THE SUPERINTENDENT OF PUBLIC WORKS.

Discharge pipes at Woodhull reservoir on "change of plan."

Proposed dam across Black river, certified by the division engineer as having been exhibited for a letting held at Albany, July 27, 1865.

Plan for a dam at Forestport (at head of Forestport pond) dated February 13, 1885. The dam was subsequently built in accordance with this plan.

Plans for the "proposed tree dam on Beaver river at Stillwater," approved and signed by the State Engineer and Surveyor, July 22, 1885. An estimated cost aggregating \$19,000 is attached to this plan.

Plans for raising Beaver River dam at Stillwater, pursuant to chapter 469, Laws of 1892, signed and transmitted by the division engineer, August 2, 1892; examined, approved and signed by the State Engineer and Surveyor, August 20, 1892.

Plans for completion of dam on Black river above Forestport pond, chapter 494, Laws of 1892, signed and transmitted by the division engineer June 30, 1892; examined, approved and signed by the deputy State engineer and surveyor, July 5, 1892.

Plan for raising roads and bridges on highways across the reservoir above Forestport pond, chapter 494, Laws of 1892, signed and transmitted by the division engineer, June 30, 1892; examined, approved and signed by the deputy State engineer and surveyor, July 5, 1892.

Plans for bridges over Beaver River reservoir at Stillwater, chapter 224, Laws of 1893, signed and transmitted by the division engineer, May 29, 1893; examined, approved and signed by the deputy State engineer and surveyor, May 31, 1893, and adopted by resolution of the Canal Board and signed by the acting clerk, June 2, 1893.

Proposed road over spillway at North Branch reservoir, chapter 148, Laws of 1895, signed and submitted by the division engineer, July 8, 1895, and examined, approved and signed by the deputy State engineer and surveyor, July 18, 1895.

Proposed discharge pipes for North Branch reservoir, chapter 148, Laws of 1895, signed and submitted by the division engineer, July 5, 1895, and examined, approved and signed by the deputy State engineer and surveyor, July 19, 1895.

Plan for repairing and completing Dustin's road across Forestport reservoir, chapter 947, Laws of 1896, signed and submitted by the division engineer, September 14, 1896, and examined, approved and signed by the State Engineer and surveyor, September 16, 1896.

Plan of masonry for spillway at Canachagala lake, chapter 947, Laws of 1896, signed and submitted to the State Engineer and Surveyor by the division engineer, September 1, 1896; examined, approved and signed by the deputy State engineer and surveyor, September 16, 1896, and adopted by resolution of the

Canal Board and signed by the clerk of said Board, September 18, 1896.

Plan of masonry for spillway at Woodhull reservoir, chapter 947, Laws of 1896, signed and submitted to the State Engineer and Surveyor by the division engineer, September 1, 1896, examined, approved and signed by the deputy state engineer and surveyor, September 16, 1896, and adopted by resolution of the Canal Board and signed by the clerk of said Board, September 18, 1896.

Plan and bill of material for rebuilding new masonry abutments and timber bulkhead at Twin Lake dam, chapter 947, Laws of 1896, submitted to the State Engineer and Surveyor, and signed by the division engineer September 1, 1896, examined, approved and signed by the deputy State engineer and surveyor September 16, 1896, and adopted by resolution of the Canal Board and signed by the clerk of said Board September 18, 1896.

Plan for rebuilding a portion of Sand Lake dam, also putting in Ludlow valves, iron rack and new gatehouse, chapter 947, Laws of 1896, submitted and signed by the division engineer August 6, 1896, examined, approved and signed by the deputy State engineer and surveyor September 16, 1896, and adopted by resolution of the Canal Board and signed by the clerk of said Board September 18, 1896.

MAPS ON FILE IN THE COUNTY CLERKS' OFFICES.

On page 523, Book 75 of Deeds, in the county clerk's office at Herkimer, Herkimer county, a map of "Woodhull Lake Reservoir" is shown, dated Albany, April 22, 1859. Said map was recorded at 1 o'clock p. m. August 13, 1859.

On page 522 of said book, the following is recorded in relation to an award by the canal appraisers for land appropriated for Woodhull reservoir:

"AWARD.

"In the claim of Henry Wager against The State of New York.

"Herkimer county, by Ashbel B. Parmelee, William Wasson, Henry H. Hull, canal appraisers.

“This is a claim for the appropriation of 396.76 acres of land belonging to claimant, including 758.20 acres of land covered with water for the Woodhull Lake reservoir. The premises are a part of what is known as the Moose River Tract, in the northern part of the county of Herkimer, and adjoining the famed ‘John Brown Tract.’ The premises were personally examined by the appraisers in the month of June, 1855, and the accompanying testimony was taken at the city of Albany on the 2d of March, 1858. The situation of the premises appropriated will be seen from the annexed map, which is made a part of this award.

“The Woodhull Lake reservoir has not as yet been completed, but a portion of the land appropriated had been flowed, so as to destroy the timber, and another portion of it had been chopped over at the time of our examination of the premises in June, 1855. How much has been done since we don’t know nor do we regard it as important, as the land was formerly appropriated and taken possession of by the State prior to that time. The land, situated as it was, some ten miles in the depth of the forest and remote from any settlement, we do not regard as very valuable; indeed, land in that locality can hardly be said to have any fixed market value, except in large tracts, and in such cases they rarely change hands but are held in the hopes that the march of civilization will, at some day, make inroads upon them and enhance their value, but when the good time coming will actually come when those wilds will be inhabited by other than denizens of the forest, no one can tell. Claimants ask compensation not only for the land covered with spruce and hemlock, but for that covered with water as well as for the destruction of the water power at the outlet of the lake. We allow nothing for the land under water for the reason that we regard it valueless. The water power would not be destroyed by the erection of a dam at the outlet, as the water could be used in passing as it should be drawn off as well as before. It would, however, be under the control of the State, and the claimant could avail himself of it only at such times as the State should see fit to draw off the water for the use of the canals. We propose to allow for the land appropriated \$1.75 per acre for the land and

regard this allowance sufficiently liberal to cover any real or fancied injury which may be sustained by the water power. We therefore make allowance and award as follows:

For 396.76 acres of land, at \$1.75 per acre.....	\$694 33
Interest for four years.....	194 41
	<hr/>
	\$888 74
	<hr/> <hr/>

“ Which sum of eight hundred and eighty* dollars and seventy-four cents we hereby award the claimant in full for all claim for damages in the premises.”

(Signed)

H. H. HULL,
A. B. PARMELEE,
WILLIAM WASSON.

A map of the reservoir on Black river, at the head of the Forestport pond, bearing the signature of the division engineer of the Middle Division, was filed in the office of the county clerk in the city of Utica, Oneida county, September 13, 1892.

Maps were also placed on file in the Oneida county clerk's office at Utica September 26, 1896, for sixty-four parcels or pieces of land, amounting to 753 47-100 acres in the aggregate, which amount was permanently appropriated for a reservoir on Black river at the head of the Forestport pond, for canal purposes.

MAP ACCOMPANYING THIS REPORT.

The accompanying map of the watershed supplying the reservoirs in the Adirondack forest, shows the reservoirs in present use and those abandoned by law; also one not in use since the failure of its dam in 1896. Of those in present use, the North Lake, Woodhull, South Lake, Sand Lake, Canachagala Lake, Twin Lakes and the reservoir at the head of the Forestport pond, furnish water to the Black River canal and to the Erie canal; while the two reservoirs on the Fulton Chain of lakes (the first, second, third and fourth lakes forming one reservoir, and the sixth and seventh lakes the other), and the reservoir

* The last "8" is omitted in the script.

on Beaver river at Stillwater, furnish water to the Black river improvement and to the water powers along Black river. Those abandoned by law were the first, second and third Bisby lakes and the White Lake reservoirs.

The one not in use since its dam failed in 1896 is the Chub Lake reservoir. A break occurred in said dam during the spring freshets that year and has not yet been repaired.

The location at Chub lake or "Chub pond," as it is more commonly called, is a very desirable one for a reservoir. But instead of attempting to repair the old, dilapidated, low, wooden dam, or to rebuild it upon the same plan and with similar perishable material, it would be much better to build an entirely new dam, using only the most durable material in its construction, and erecting it to a height that would impound the large amount of water contemplated when the map and plans were adopted in 1855 for a reservoir at that place. Upwards of \$9,000 were expended at that time towards the erection of a dam that would have afforded a reservoir with a surface area of 530 acres and a depth of 25 feet. But the work was stopped in 1856 for the want of funds, and was not resumed when an additional appropriation provided for the completion of the reservoirs upon which work had been started.

The others upon which work had been stopped were completed, and it was then thought that the three that were completed would suffice; and for that reason Chub lake was not completed. But the lack of a full supply of water to maintain uninterrupted navigation whenever an extremely dry season occurs, shows the necessity for more reservoirs, and as Chub lake is one of the most desirable locations in the North Woods for a reservoir, and as the State has an undisputed right and title to the lake and the land surrounding it, a reservoir should be established there as soon as the means can be made available for its construction.

It would benefit the State to a far greater extent and be very much better every way and for all parties concerned to construct Chub Lake reservoir than to attempt to bring the three Bisby lakes into service again as reservoirs.

It will be seen by referring to the tables of reservoirs on pages 13 and 60, that the capacity of Chub Lake reservoir, if built as

planned and adopted in 1855, and partially constructed that year and the year following, would be nearly ten times as much as the amount that was impounded in the first, second and third Bisbys combined.

It will also be seen by referring to the map, that all of the water from the four Bisby lakes, as well as from the Wolf, Woodhull, Mud and Sand lakes and their tributary streams, flows through Chub lake on its course down Big Woodhull creek to the State pond at the head of the feeder at Forestport. The water that these several lakes and their watershed could furnish would, if rightly and judiciously managed, insure the filling of the Chub Lake reservoir a number of times each year, and the water from this reservoir could reach the feeder in very much less time than from any of those now in use, except the one at the head of the pond at Forestport.

In my opinion, it would not be wise nor just for the State to take possession of the Bisby lakes (which were abandoned by law in 1889) and bring them into use again as reservoirs.

The amount of water impounded there was comparatively insignificant, and the same amount (the same water in fact) that would be impounded in the Bisbys, if reappropriated by the State, could be added to and stored in a reservoir at Chub lake by building a dam at said lake a trifle higher than the one contemplated by the plan which was adopted by the Canal Board in 1855. The additional cost of a higher dam would probably not be any more than what it would cost to put the old dams and bulkheads in serviceable condition at the Bisbys; and by having but one dam, the expense for maintenance and for gate tending would be less than it would be in case both reservoirs are brought into use again. And besides the saving to the State, there is a greater and by far more important reason why the Bisby lakes should not be used as impounding reservoirs. These lakes and their immediate surroundings are widely known and eagerly sought as an ideal place for a summer resort. The tract of land encompassing these lakes was formerly owned by the "Bisby Club," but now belongs to the "Adirondack League." Members of said club and league have been to a good deal of expense in building cottages and making improvements, striving

to make the place and its surroundings more desirable and attractive if possible, and said members with their friends and invited guests have made annual visits to this delightful summer resort to recuperate in health and for rest and recreation, and it is unjust to them to do anything that will detract from the place or make it unhealthy or in any way less desirable.

The work done there by the State in building the dams and bulkheads which raised the surfaces of the lakes but a few feet, was not so very objectionable, but it was the drawing down of the lakes right in midsummer that proved so detrimental, and it was this undesirable feature that led up to the passage of the law in 1889, abandoning the Bisby lakes and White lake as reservoirs.

On page 68, I have explained the views and actions of the Superintendent of Public Works in relation to that part of the law which directed the abandonment of those reservoirs. I know that the Superintendent acted in good faith in the matter in refusing to remove the gates and abandon the dams at those lakes, for he believed the reservoirs to be a permanent and an essential part of the canal system, and for that reason he thought they should not be dispensed with. But notwithstanding that I have instituted a very thorough search in the office of the State Engineer and Surveyor, the Superintendent of Public Works and the Comptroller, in which search I was ably and kindly assisted by the custodians of the records in said offices. We failed to find any positive proof that the Bisby lakes were permanently appropriated for reservoirs. They were undoubtedly brought into temporary use under the urgent necessity for sufficient water to avert the suspension of navigation, which seemed imminent during those extraordinary dry seasons of 1879, 1880 and 1881.

White Lake reservoir, however, which was also abandoned by law in 1889, was adopted by a resolution of the Canal Board, and the map, which was officially signed by the division engineer, the State Engineer and Surveyor and the Canal Auditor, is on file in the office of the State Engineer. And unless the impounding of water in that lake, and drawing it down in dry seasons proves detrimental to the health of the inhabitants in that vicinity, I can see no good reason why White lake should

not be reclaimed by the State and brought into use again as a reservoir for canal purposes. The dam has not been removed and it would not cost a very large sum to build a new bulkhead, put in new gates and make the needed repairs to bring the reservoir into service again.

Plans were adopted by resolutions of the Canal Board in 1896 for making repairs and improvements at the Twin Lakes and the Canachagala Lake reservoirs; and maps of the the reservoirs are on file in the offices of the State Engineer and Surveyor at Albany, and of the division engineer at Syracuse; but said maps are not officially signed and certified to, nor are there any records upon them to show that they were adopted by resolution of the Canal Board.

The question should be definitely determined, if possible, whether the State has a clear title to these lakes and reservoirs or not, and if not, the necessary steps should be taken to acquire title to these and to any of the others regarding which there may be any question or doubt as to the State's ownership.

That part of the law which directs that copies of the maps shall be filed in the county clerk's office has not generally been complied with. In my search at the offices in Oneida and Herkimer counties, I found only those that are spoken of on pages 99, 100 and 101.

I did not make a search in the clerk's office in Hamilton county. The only State reservoir in that county is the one at Sixth and Seventh lakes of the Fulton Chain, and probably the map of that reservoir was not recorded in the county clerk's office, for I did not find it was ever adopted by a resolution of the Canal Board.

Very respectfully submitted,

DAVID E. WHITFORD.

Canal Engineer's Office,

Syracuse, N. Y., November 4, 1898.

Errata.

On page 6 it is stated that the boundary lines between New York, Pennsylvania, New Jersey and Massachusetts have been fully surveyed, mapped and monumented.* The New York State half of the Massachusetts line was not monumented.

In the last paragraph on page 67 mention is made of the "Adirondack Lake Club." This should read "Adirondack League Club."

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